Science Textbook

Year 3–4

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Letts

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Contents

How do I get the best out of this book?

How is the book organised?

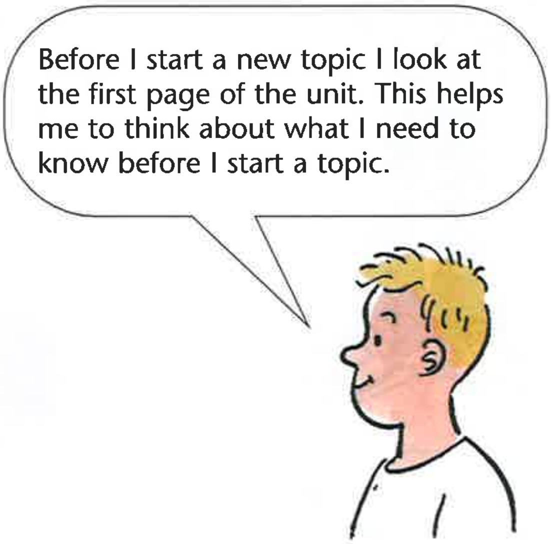
The **contents page** near the front of the book shows you the topics in each unit.

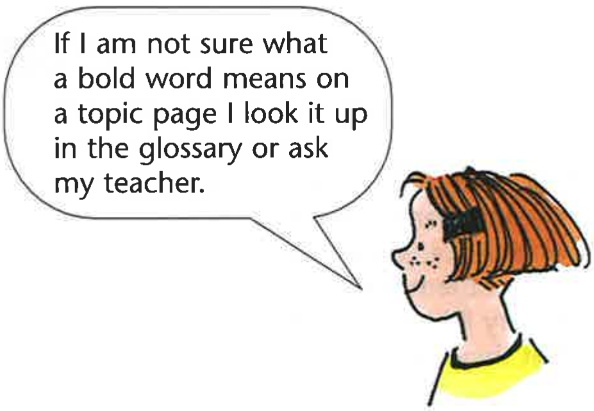
Each chapter has a different colour to make it easier to find. For example, 'Keeping animals healthy' is blue.

There are **seven units** in the book. Each unit is organised in the same way. They have:

- an **introduction page** – The top part of this page tells you what you should already know. Use this to check what you can remember about each topic. If there is something you don't know, you will have to do some catching up. The bottom part of the page shows you what you will learn in the unit.
- **topics** – These are shown across two pages and tell you the science you need to learn.
- a **'Test your knowledge' page** at the end of each unit – This has interesting questions to test what you have learnt.

At the end of the book there is a **glossary**. This has important science words for each unit and tells you what they mean. These words are shown in **bold** on the topic pages.

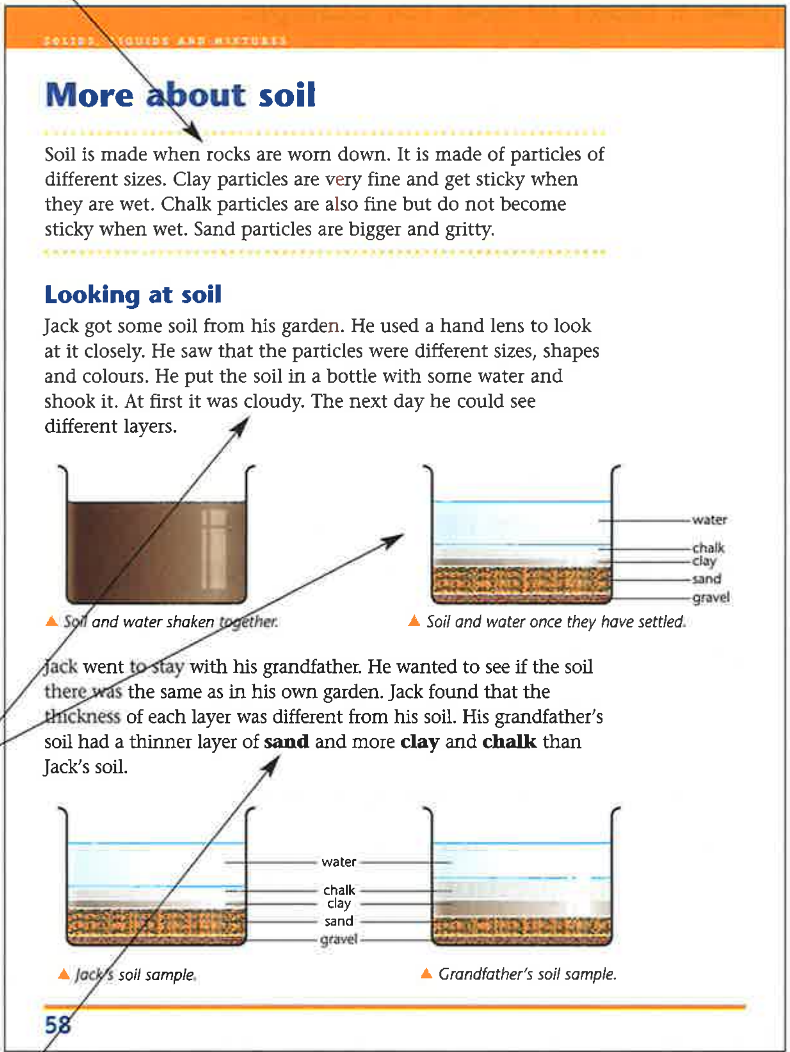




How do I use the topic pages?

Each topic is shown across two pages and is set out in the same way.

The summary tells me the key things I need to learn and understand in the topic.



SOLIDS, LIQUIDS AND MIXTURES

More about soil

Soil is made when rocks are worn down. It is made of particles of different sizes. Clay particles are very fine and get sticky when they are wet. Chalk particles are also fine but do not become sticky when wet. Sand particles are bigger and gritty.

Looking at soil

Jack got some soil from his garden. He used a hand lens to look at it closely. He saw that the particles were different sizes, shapes and colours. He put the soil in a bottle with some water and shook it. At first it was cloudy. The next day he could see different layers.

▲ Soil and water shaken together.

▲ Soil and water once they have settled.

Jack went to stay with his grandfather. He wanted to see if the soil there was the same as in his own garden. Jack found that the thickness of each layer was different from his soil. His grandfather's soil had a thinner layer of **sand** and more **clay** and **chalk** than Jack's soil.

▲ Jack's soil sample.

▲ Grandfather's soil sample.

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The words and pictures help me to learn more about science. I need to be able to describe science using my own words and pictures to tell others what I mean.

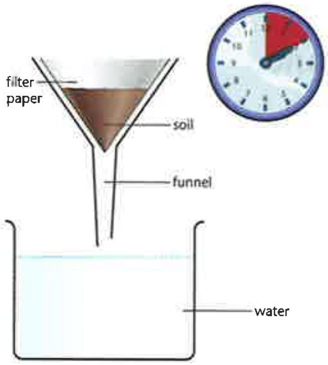
Bold words are science words I need to learn and use in my own science work. I can look most of them up in the glossary if I am not sure what they mean.

Many drawings have captions and labels. These help me to understand the pictures. I need to draw and label my own drawings like the ones in the book.

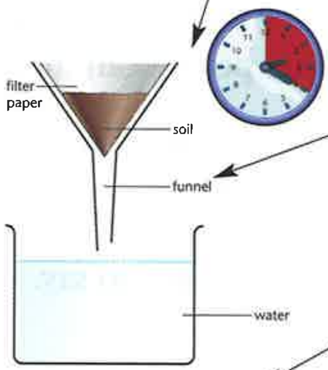
SOLIDS, LIQUIDS AND MIXTURES

Soil drainage

Jack tested the two soils to see which would let water run through the fastest. His grandfather said that this was called testing soil drainage. Jack put the same amount of each soil into different funnels and poured 100 ml of water into each one.



▲ *Jack's garden soil let the water through quickly.*



▲ *His grandfather's soil let the water through much more slowly.*

label

caption

Jack's soil had less clay and more sand than his grandfather's. Sand particles are bigger and have more air spaces between them. The air spaces let the water drain through more quickly.

Grandfather's soil had a lot of clay which is made from very fine particles. The water could only drain through it slowly as there were smaller air spaces between the particles.

1 What can be found in the soil samples that Jack and his grandfather tested?

2 Why do sandy soils let water run through more quickly than clay soils?

3 Jack's teacher gave the class some seeds to take home to grow. On the packet it said that the seeds needed well-drained soil. In whose garden would they grow best, Jack's or his grandfather's? Explain why.

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The questions will show me how well I have learnt the topic.

There are more questions on the 'Test your knowledge' page at the end of each unit. These will test how well you have understood the science you have learnt.

Things to remember

- **Read the words carefully.** You might not understand everything the first time you read it. Read each sentence slowly a few times. Then it should make more sense. If it doesn't, then ask your teacher what it means.
- It is important to make sure you **spell words the right way**. The words you must learn to spell are written in **bold** letters. Try to learn these words and use them in your own science work.
- **Learn the science facts** and try to understand the **science ideas**. These explain why things happen. Try to use these facts and ideas in your own science writing. You need to explain things clearly so that other people can understand.
- **Answer the questions well**. Always write in full sentences. Spell each word correctly. Always try to use the right science words in your answer. Use the words and pictures on the topic pages to help you work out what you need to say. Check your answer and try to make it better.
- **Use the correct ways of writing and drawing**. Make sure that you use the right units and symbols. Always label drawings clearly and properly.
- **Set your work out properly**. Follow the rules your teacher has told you for setting out your work. Number the questions in the right order. Cross out any mistakes neatly. Space your work sensibly on the page.

Keeping animals healthy

Before you start you should know that:

- humans and other animals are living things
- humans need food and water to stay alive
- taking exercise and eating the right food helps you to stay healthy
- different people like different foods

At the start of this unit you will learn about eating and teeth and:

- how animals are alike and different
- that an adequate and varied diet is needed to keep healthy
- that different animals have different diets
- that the shape of teeth helps animals to eat their particular foods

Later in the unit you will learn more about how animals move and grow and:

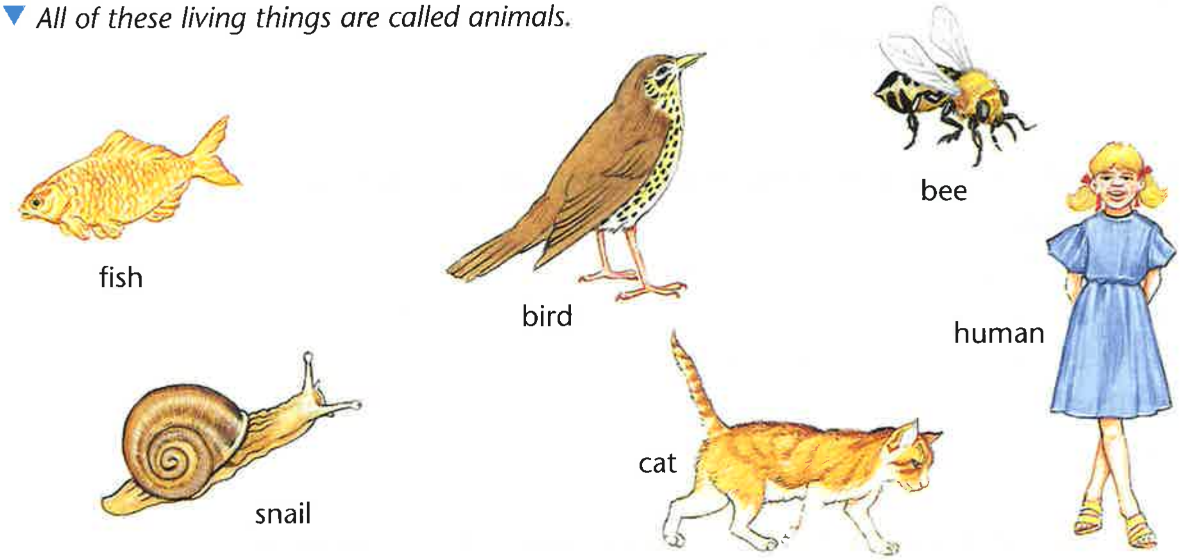
- how bones help you stand up and move
- how muscles can make you move
- what changes take place in your body when you exercise

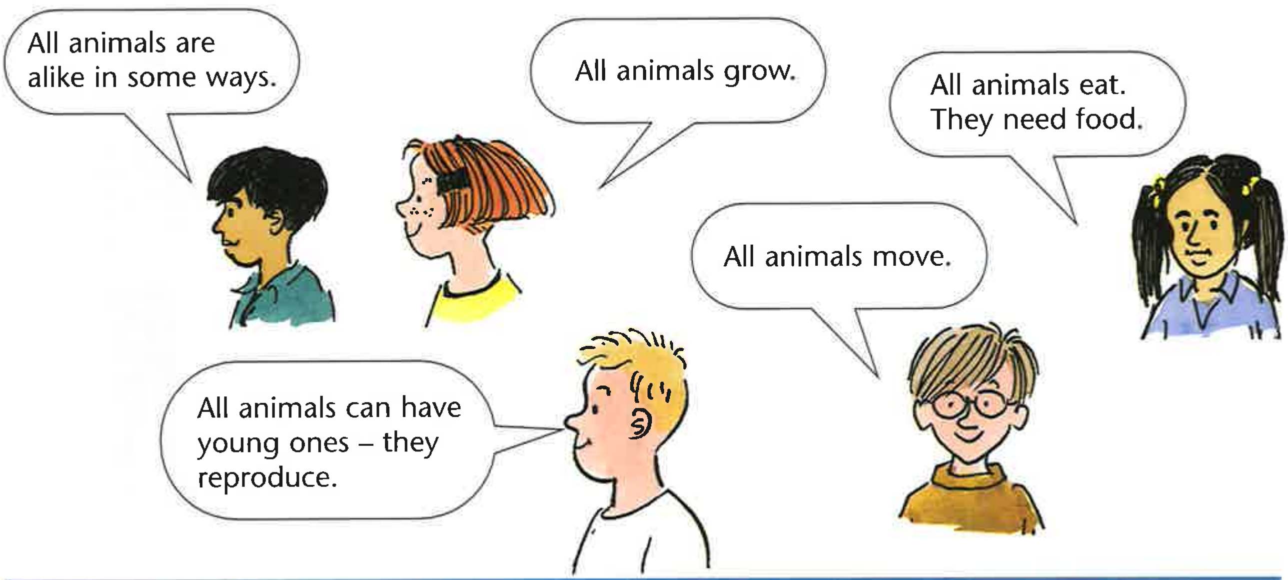
Living animals

Living things are sorted into two groups, animals and plants. All animals need food, and they all grow and move. They also reproduce and get rid of waste from their bodies. Animals can be divided into different groups such as birds, fish and insects. The animals in each group are alike in some ways.

All sorts of animals

▼ *All of these living things are called animals.*





How are animals put into groups?

Animals are sorted or classified into different groups. Birds, **mammals**, insects and fish are some of the groups.

All animals in a group are the same in some ways but they also have some differences.

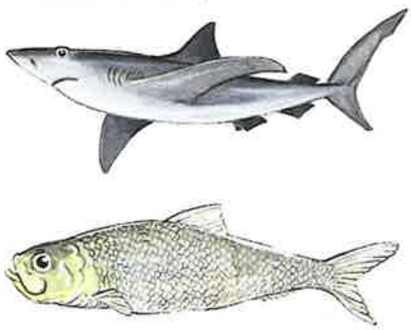
▼ *These are birds.*

They both have wings.
They both lay eggs.

▼ *These are insects.*

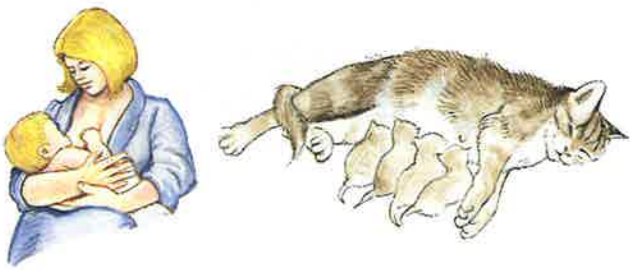
They both have three body parts.
They both have six legs.

▼ *These are fish.*



They both have gills.
They both have fins.

▼ *These are mammals.*

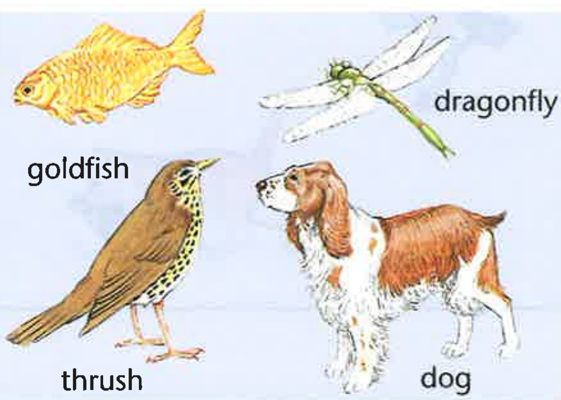


They both have live babies.
The mothers make milk to feed their babies.

1 Write down the names of the two big groups of living things.

2 List four things that all animals can do. Begin your sentence 'All animals can … '

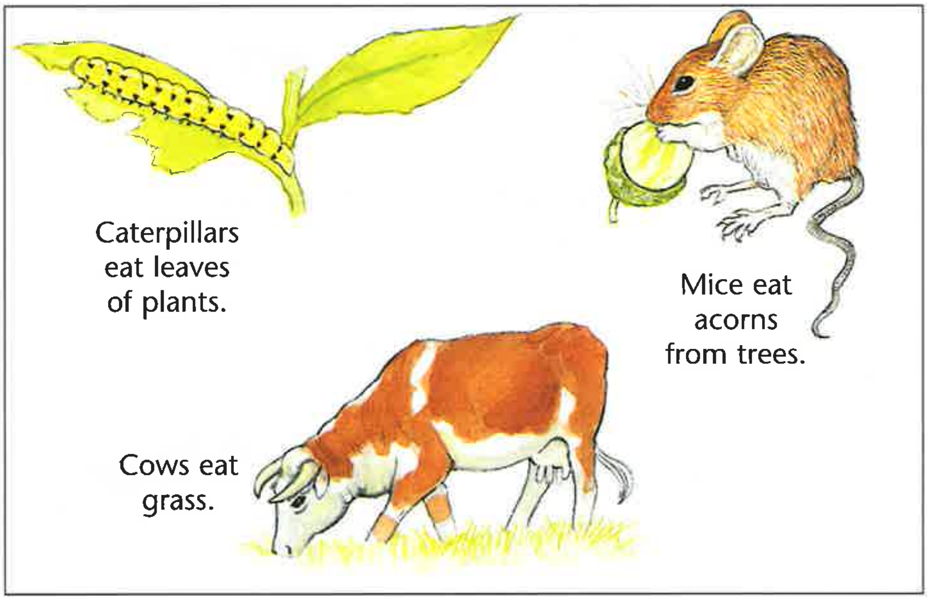
3 Which group do each of these animals belong to? Write your answers in sentences.



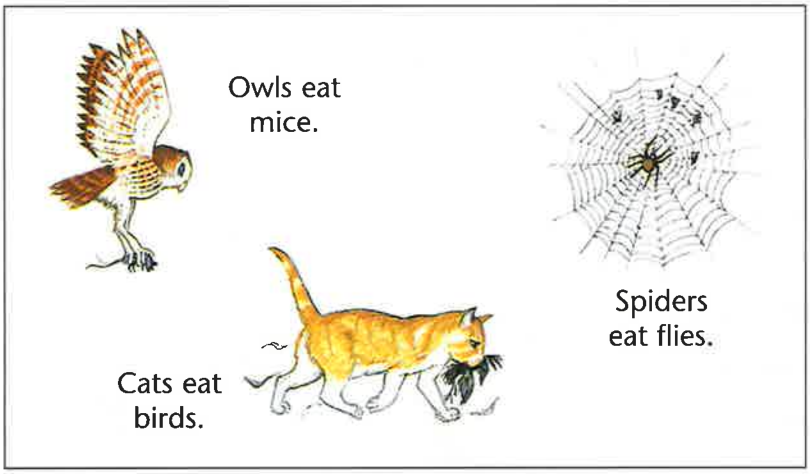
Food and feeding

Plants and animals are linked together through food. Green plants can make their own food by using energy from the Sun. Some animals get their food by eating plants. Some animals eat other animals. Humans can eat plants and animals.

What do animals eat?



All animals eat. They need food to grow and be active. Some animals only eat plants. They are called **herbivores.**

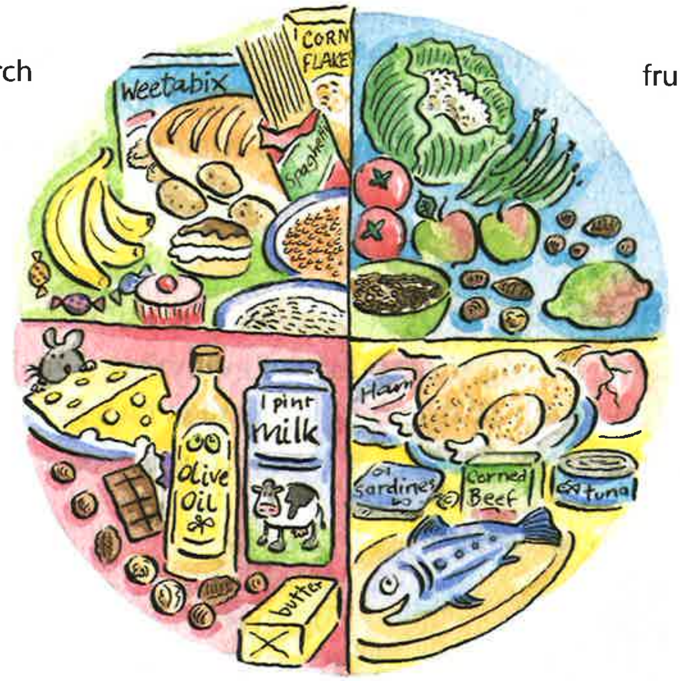


Animals which only eat meat are called **carnivores**.

Humans are **omnivores** because they eat plants and animals.

How can we group foods?

We need a variety of foods to be healthy.



1 Find a plant, a herbivore and a carnivore in the pictures.
Write your answers like this
'A squirrel is a ....
because ....'

2 Choose a word from the box to finish each sentence.

Spiders eat .... Mice eat ....

Cows eat .... Cats eat ....

birds	grass
acorns	flies

3 Copy the table and add examples for each group of food. The first row has been done for you.

sugar and starch	fats	fruit and vegetables	fish and meat
potato	oil	orange	chicken

Diets

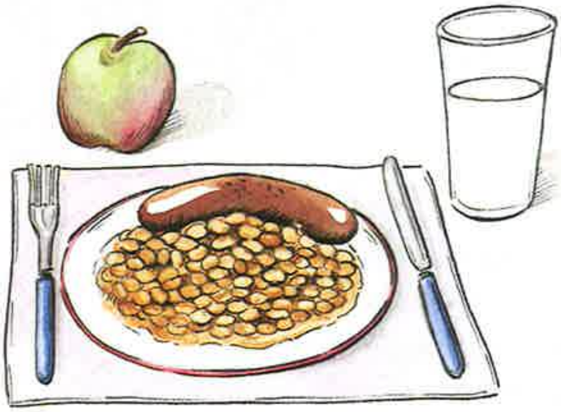
We do not all eat the same types of food. People from different countries eat different foods depending on what they can grow and what their familes eat. We all need a varied diet to be healthy. Some people have illnesses that mean they need to eat special foods.

What is a balanced diet?

A balanced diet contains the right amounts of everything we need to be healthy. Too much of one type of food is bad for you.

▼ *This was Clare's meal.*

▼ *This was Daniel's meal.*



Who will have the healthier meal?

Are vegetarians healthy?

Some people only eat food that comes from plants. This may be because they think it wrong to eat animals or they may not like fish and meat.

They still have a balanced diet if it contains all they need for healthy growth. If they only ate green plants like lettuce they would be ill.

Mina is a vegetarian. Her meal has everything she needs for being active and for growing.

What do different people eat?

These children have chosen their favourite meals.

Lin's meal is rice, fish, prawns and vegetables.

Ali's meal is vegetable curry, rice and lentil dahl.

Rosa's meal is spaghetti, meat, tomatoes and peppers.

These are all healthy diets as they contain a balance of food for growth and food for being active.

Who needs a special diet?

Many people need special diets. Some diets are needed by people who have an illness.

Jack's father had a heart attack. When he recovered he was given a special diet of foods with low fat and low salt. He was told he must take more exercise.

Some people want to lose weight. They have a slimmer's diet which is low in fat and sugar. They also need to take more exercise.

1 Clare is going on a picnic. Plan a healthy meal for her to take.

2 Daniel has a meal of chicken curry, lentil dahl and rice. Will this provide what he needs to be active and to grow?

3 Which meal or type of food is the most popular in your class? Choose questions to help you find out. Show what you find out in bar charts.

Teeth

Many animals need teeth so they can eat their food. Teeth are different shapes to suit the type of food each animal eats. Human babies are usually born without teeth. Then humans grow two sets of teeth during their lives. If you eat too many sugary foods and do not clean your teeth they can **decay**.

We need teeth to eat food

Look at the teeth of these animals.
They help the animals to eat their different foods.

This is a rabbit.

Rabbits eat plants.
Rabbits are **herbivores**.

This is a fox.

Foxes eat meat.
Foxes are **carnivores**.

This is a human.

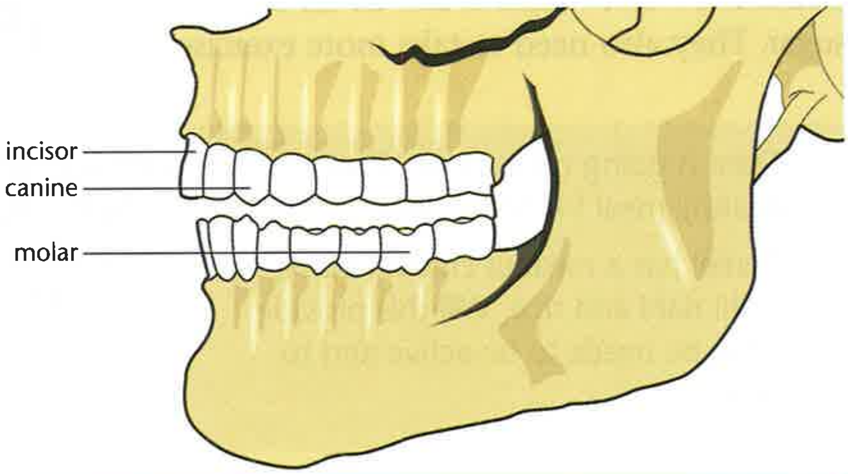
Humans can eat meat and plants.
Humans are **omnivores**.

Humans also have teeth of different shapes. Each kind of tooth does a different job. Look at your teeth. Can you see the different shapes?

Incisors are sharp, for biting food.

Canines are pointed, for holding and tearing.

Molars have flat tops for grinding.



What happens to our teeth?

Most human babies are born without teeth. Babies do not need teeth because they drink milk and eat soft foods. They do not need to bite and chew.

child

Young children grow a set of 20 teeth. These are called **milk teeth**. These teeth fall out when **permanent teeth** grow. Adults have a set of 32 permanent teeth.

adult

Teeth can decay if you:

- eat too many sticky sugary foods;
- do not clean your teeth regularly.

1 Finish the sentences by writing down what kind of food each of these animals eats.

a Rabbits and sheep eat ....

b Foxes eat ....

c Humans eat ....

2 Name the teeth which are especially shaped for each of the following:

a grinding food **c** tearing food

b biting food

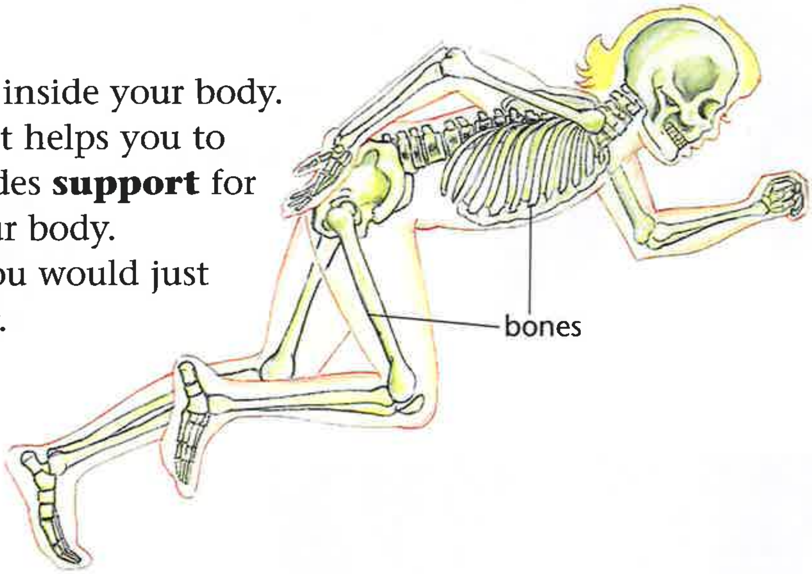
3 Write down two things you can do to stop your teeth decaying.

Bones

Humans have skeletons made of bones. The skeleton holds the body up and protects the soft parts inside. Between bones are joints which allow the body to move. Some animals do not have bony skeletons, but they still need support.

Your skeleton

You have a **skeleton** inside your body. It is made of **bones**. It helps you to stand up and it provides **support** for the softer parts of your body. Without a skeleton you would just be a blob on the floor.



Joints between the bones help you to move different parts of your body in different ways.

What happens when you grow?

Your skeleton grows from before you are born until you are an adult. Not everyone grows at the same rate. Some children in your class will be taller than others but this may change as you get older.

Who is taller at 8 years old?
Who is taller at 14 years old?

Do all animals have skeletons?

Many animals have bony skeletons inside the body, such as fish, reptiles, birds and mammals. Animals with bony skeletons inside the body are called vertebrates.

▼ *This dinosaur had a large bony skeleton.*

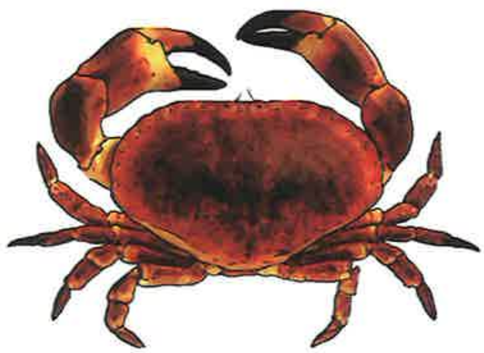
How do other animals support themselves?

Some animals have liquid inside them. Earthworms, slugs and caterpillars are like this. This liquid supports the body. Muscles in the skin push against the liquid inside to keep the body firm.

▼ *An earthworm.*

Others animals have a hard outer skeleton. This covers and protects the softer parts inside their bodies. Crabs, spiders and beetles are like this.

▼ *A crab.*



1. Explain why you need a skeleton.
2. Find some pictures of skeletons of other animals. How are they the same as a human skeleton? How do they differ?
3. Measure the height of some of your friends. Do taller children also have longer arms?

Muscles and movement

All animals with bony skeletons have muscles that join on to the bones. The muscles move the body. When one muscle contracts another has to relax. Muscles always work in pairs.

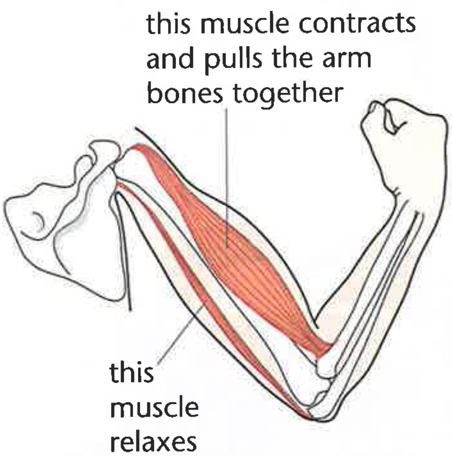
What do muscles do?

Everyone has **muscles** connected to bones. You need muscles to move.

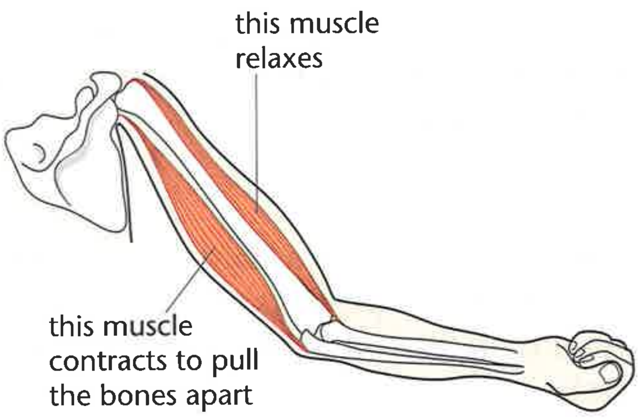
If you move your arms and legs slowly you can feel your muscles move.

You use up energy to move these muscles.

Bending your arm



Stretching your arm



Muscles always work in pairs. One muscle moves a bone one way and the other muscle moves it back again.

When a muscle contracts, it gets shorter. When it relaxes, it goes back to its original length.

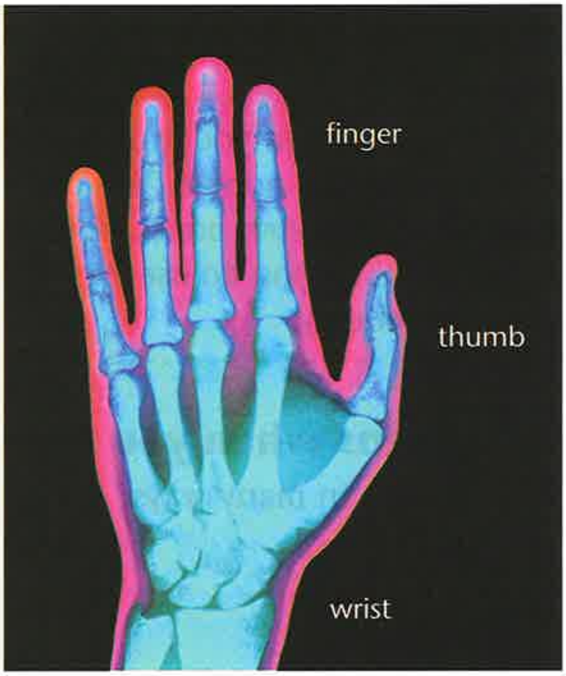
How your hand moves

Look at your hand.

How many joints can you find in your fingers?

Which way can they move?

What movements can your wrist make?



How your back moves

Some parts of your body have lots of little bones.

Look at your **wrist** and at the **backbone** in the pictures. These little bones slide against each other so you can bend and twist your body.

1 Bend your knee. Which muscle bulges when your leg is bent? Describe what happens to your leg muscles when you straighten your leg.

2 Look at an animal like a cat or a fish. How does it move? Do you think the animal has muscles and a skeleton too?

Exercise

Your body changes when you exercise. When you rest your body soon gets back to normal. You can move because you have muscles connected to your bones. You use energy to move these muscles. Some things you do use very little energy. Some things use much more energy.

What happens when you exercise?

Your body changes in many ways.

▲ *This is Jack. He gets a lot of exercise playing football.*

▲ *He uses energy to run and kick the ball.*

▲ *He breathes faster.*

▲ *His heart beats faster.*

▲ *He gets hot and sweaty.*

▲ *Then he rests.*

Soon his body is back to normal again. ▶

Understanding your body

The harder you exercise, the more your muscles have to work. They will need more energy.

When you are sitting still your muscles do not have to work hard.

How do you know this man's muscles are working hard?

▼ *Some movements use very little energy.*

You breathe gently.
Your heart beats normally.
You do not get hot.

▼ *Some movements use lots of energy.*

You breathe quickly.
Your heart beats fast.
You get hot and sweaty.

The sweat is wet on your skin so it helps to cool you down just after exercise.

If you rest, your body soon gets back to normal.

1. Write down some things you do that use very little energy.
2. Write down some things you like to do that use lots of energy.
3. Explain how your body changes when you exercise.
4. Explain what happens to your body when you rest after exercise.

Test your knowledge

1 Some animals like jellyfish have very soft bodies. They live in water.

Explain what problems the jellyfish would have if it came out of water on to land.

2 Draw arrows from the bottom line to the top line to find the right food for these animals. One has been done for you.

spider cow bird mouse squirrel snail

caterpillar acorn fly nut grass lettuce

3 Choose words from the box to finish the sentences.

A rabbit eats grass.
It is ....

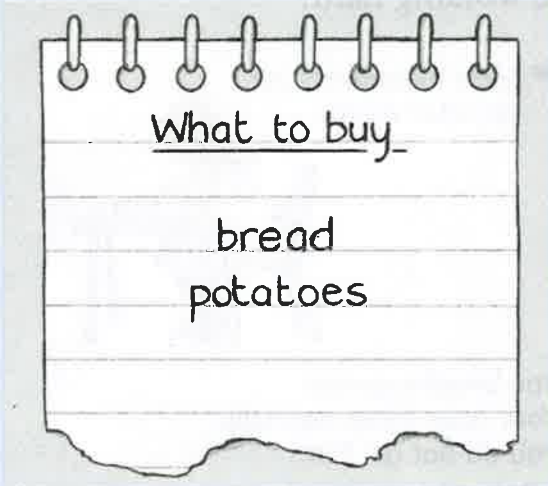
A cat eats birds.
It is ....

Sara eats fish and chips.
She is ....

an omnivore
a herbivore
a carnivore

4 Tom's mother is ill so he is doing the shopping for the week. He wants to make sure he has the right kind of food for healthy meals.

He has started his shopping list. Can you complete it for him?



5 Daniel is writing to his penfriend Jack, but some words are missing.

Copy the sentences, putting the words from the box in the spaces so Jack can understand the letter.

I get lots of .... playing football. My heart .... fast and I get all .... and .... but I have a .... at half time and I soon get back to ....

beats	**rest**	**exercise**
normal	**sweaty**	**hot**

Growing and living together

Before you start you should know that:

- plants need light and water to grow
- there are different kinds of plants and animals in the local environment
- there are differences between local environments and that these affect which plants and animals are found there

At the start of this unit you will learn about helping plants grow well and:

- how we group plants
- how to name the different parts of a plant
- that plants provide food for us
- that water is taken in through the roots, up the stem and into other parts of the plant
- that plants need light and the right amount of water for healthy growth

Later in the unit you will learn more about habitats and:

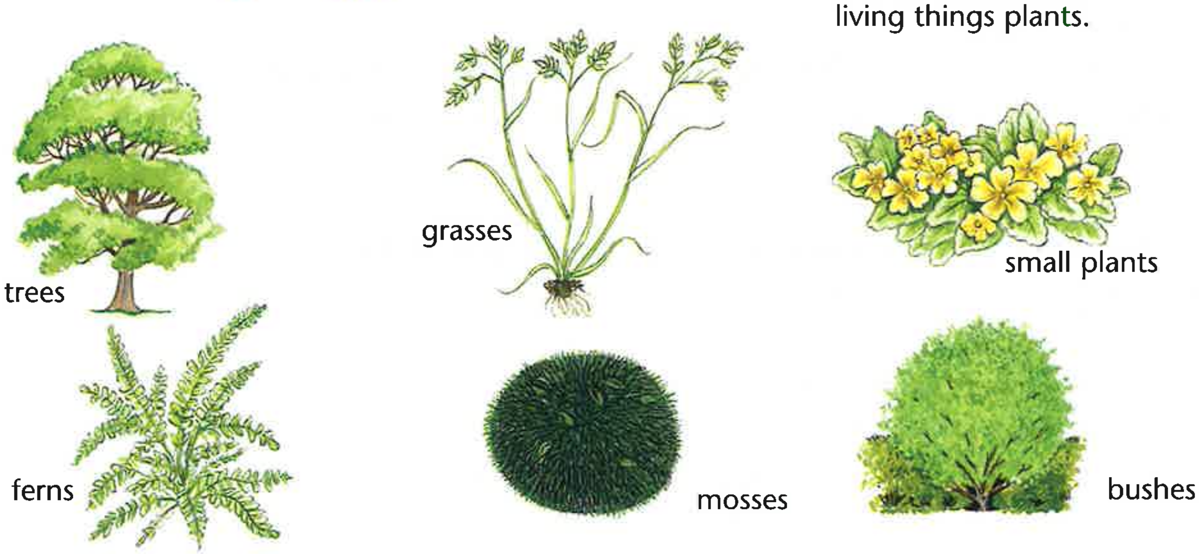
- that different plants and animals are found in different habitats
- that animals are suited to the environment in which they live
- to group organisms according to observable features
- to use keys to identify plants and animals

Plants

Plants can be sorted into groups such as mosses, ferns and flowering plants like trees, grasses and bushes. All these plants use energy from the Sun to make food, grow and reproduce. They all have different parts. Each part of a plant does a particular job.

How can we group plants?

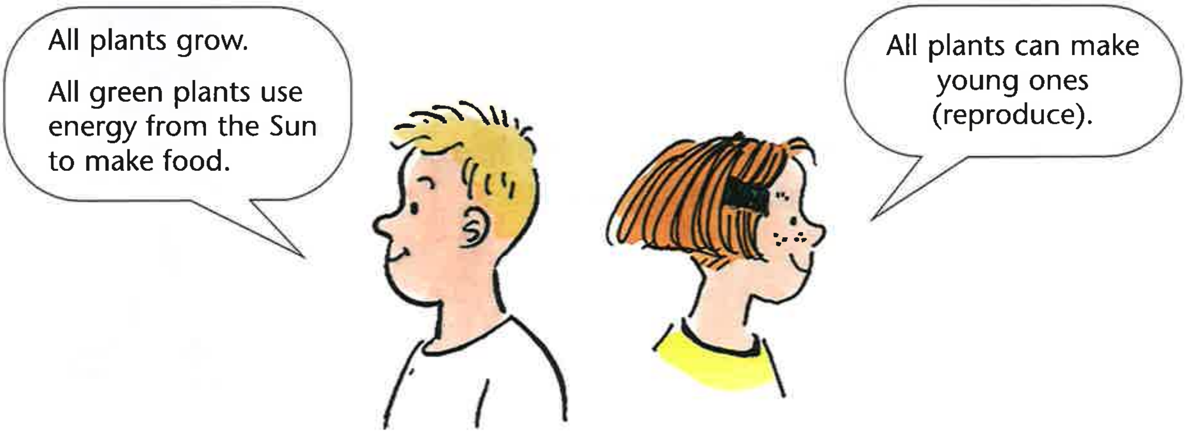
We call all of these living things plants.



All these plants are alike in some ways. They also are different in some ways. We use these differences to sort them into groups.

What do all plants do?

Plants do not have to eat food like animals do.



Parts of a plant

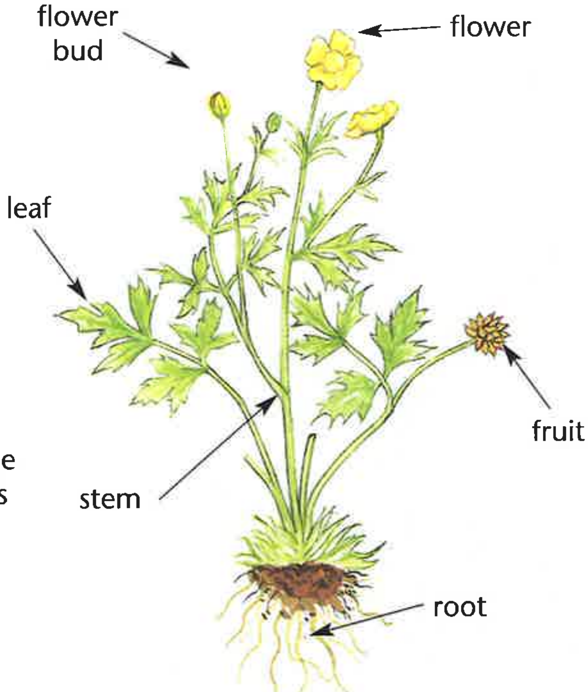
Each part of a plant is well suited to the job it does.

This plant is a buttercup. Look at its different parts and their functions (what they do).

The flower bud opens into a flower.

The green leaf uses sunlight to make food for the plant.

The stem holds the plant up and takes water and food around the plant.



The flower helps to make the fruit.

The fruit develops after the flower dies. It has seeds inside. Seeds from a buttercup will only grow into new buttercup plants.

The root takes in water and holds the plant in the soil.

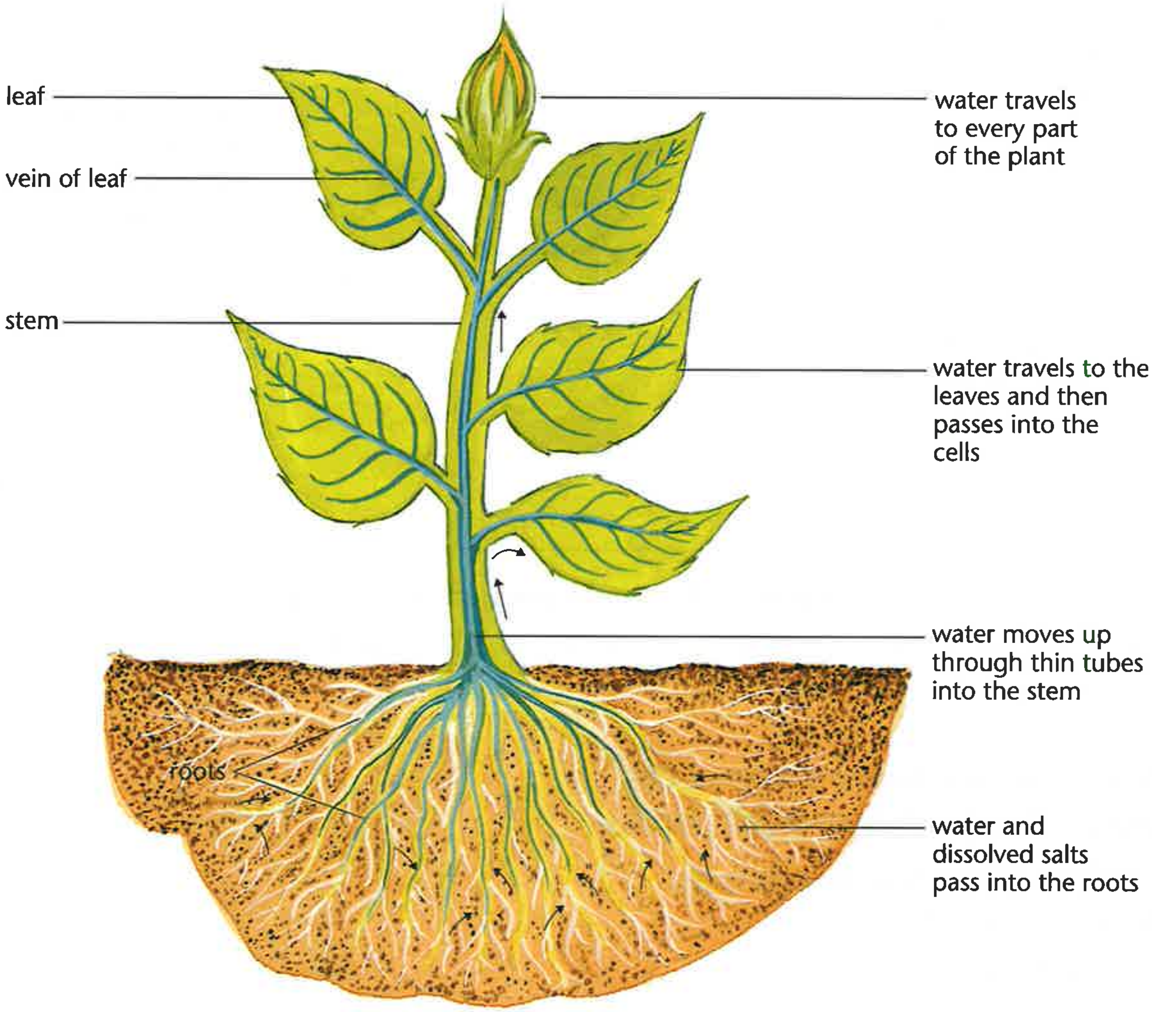
All flowering plants have **roots**, **stems**, **leaves**, flowers and fruit. The shapes of each of these change in different plants but they all do the same job.

1. Write down the names of four of the groups of living things we call plants.
2. List three things that all plants do. Begin your sentence 'All plants can … '
3. A daffodil plant grows from a bulb with little roots. Draw and label the bud, flower, fruit, leaf and stem of this plant.

How water is transported in plants

Water and substances dissolved in the water get into the plant through the roots. Long tubes carry the water from the roots, up through the stem and into the veins in the leaves. The leaves need this water to make food.

Where does the water go?

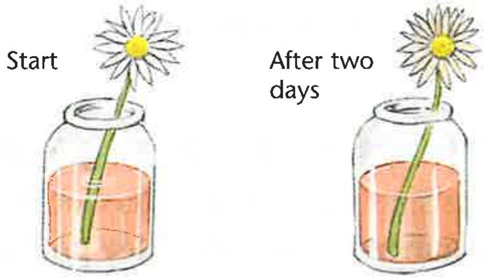


In the water there are dissolved substances such as nitrates which the plant needs. These substances are called **nutrients**.

Where does the water go?

Jack's teacher asked him to carry out experiments to find out more about how water and nutrients get into and move through plants. This is what he did.

▲ *Jack put one white flower into water with powdered red chalk.*
After two days the flower had stayed the same colour.



▲ *In a second beaker he put another white flower into water containing some red ink.*
After two days the flower petals had turned red.

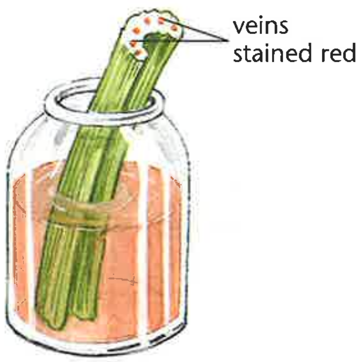
This experiment shows that only substances dissolved in the water can move through the plant. Solid material like chalk can't get in.

Where does the water go in celery?

If you put a stick of celery into water and red ink, as Jack did with his flower, it will show you where the water goes.

Cut the celery into slices to find out which parts have turned red. This will tell you where the water has gone.

▼ *Celery stalk in red ink.*



1 a Why does a plant need water?
  b What happens to a plant if it does not get water?

2 Describe how water gets from the soil to the leaves.

3 Can soil particles pass into the plant through the roots?
Describe an experiment that would test your answer.

4 Suggest how you could turn a white flower half-red and half-blue.

Growing plants

Seeds need water and warmth to begin to grow or germinate. Seeds will germinate without light, but light is needed for the seedlings to grow into healthy plants. All plants need light, water and the right temperature to continue growing.

What do seeds need to grow?

When seeds start to grow they produce tiny roots and shoots. This is called **germination**. Later they produce leaves and grow bigger.

Red class grew some cress seeds. They investigated what the seeds needed to grow into healthy plants. They tested the effect of light, water and temperature.

Seeds without light
Tom's group gave their seeds water and kept them in the warm classroom. They put them in a dark cupboard.

The seeds did germinate but they are tall and pale.

After four days

The seeds did not germinate.

After four days

Seeds without water
Clare's group put their seeds on the light window sill in the warm classroom. They did not water the seeds.

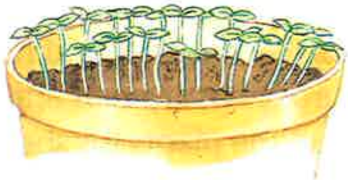
Seeds without warmth
Sara's group watered their seeds but they put them in the refrigerator.

The seeds did not germinate.

After four days

Seeds with light, water and warmth

Daniel's group put their seeds in the warm classroom on the light window sill and watered them.



Growing the cress seedlings

Red class wanted to grow their cress plants to make cress sandwiches. Only those **seedlings** that had light, water and warmth grew into healthy plants that they could eat.

▲ *All plants need these things in order to grow well.*

1 Michelle planted some bean seeds in her garden in December. They did not grow. Why do you think they did not grow? Begin your sentence 'I think Michelle's bean seeds did not grow because ...'

2 Yasmin planted some sunflower seeds in her garden. The seeds in the sunny flower bed grew well. The seeds under the shady tree did not. Explain why.

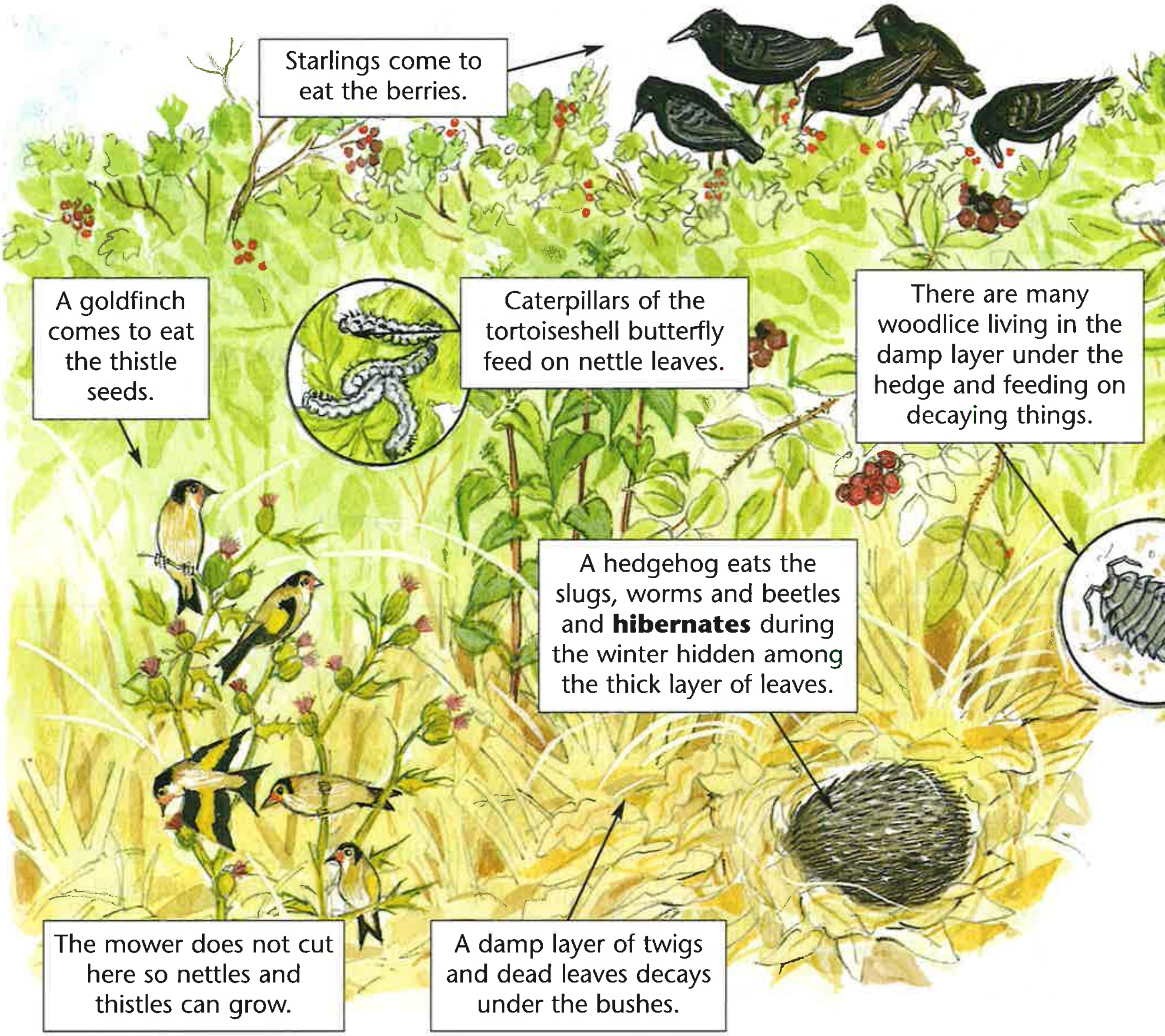
3 Write down two things seeds need to germinate.

4 Write down three things seedlings need to grow into healthy plants.

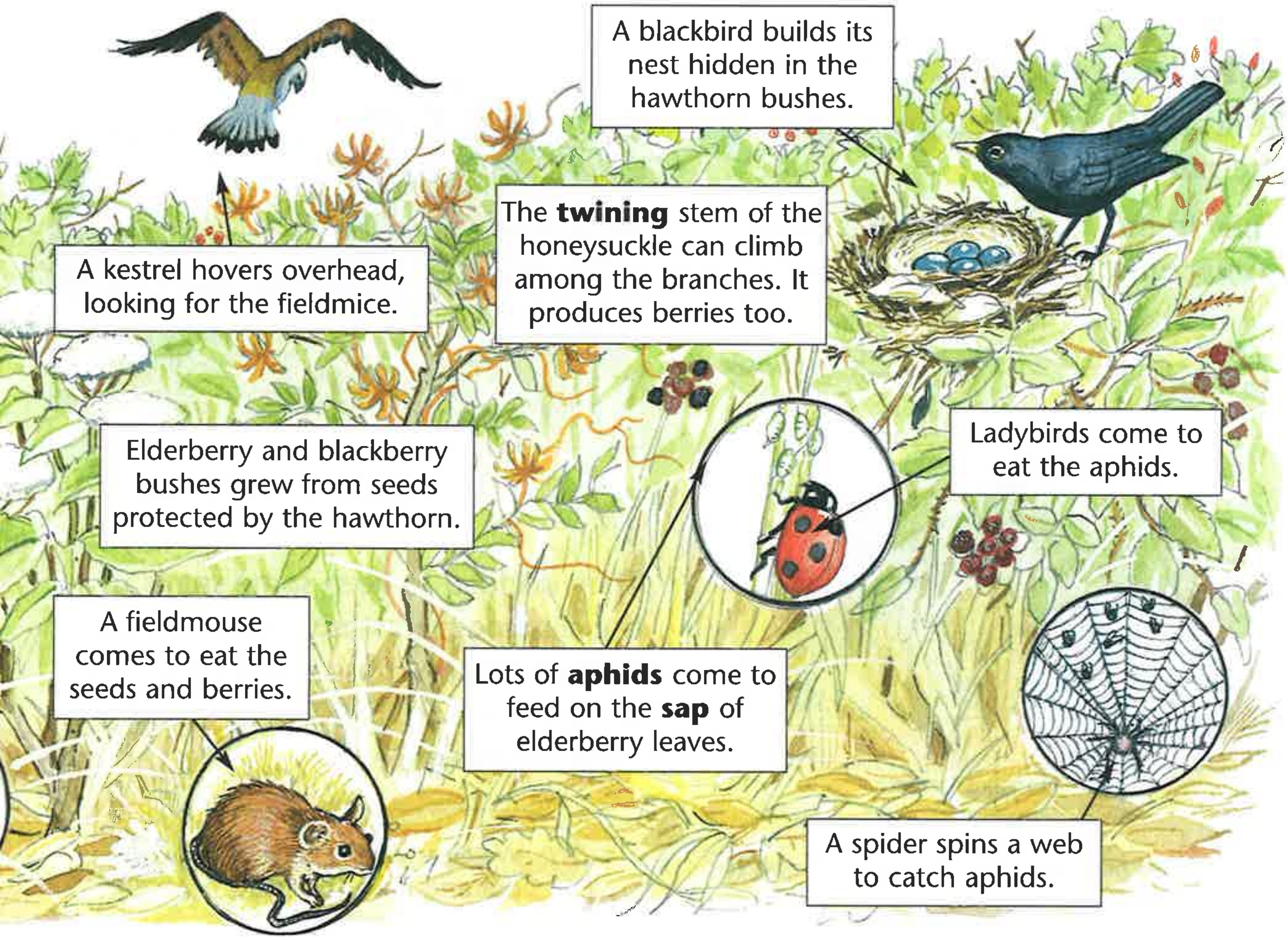
Living together

Plants and animals live together in different places or habitats. Each habitat has groups of animals and plants that need each other to survive. Animals use the plants for shelter and food. Some live there all the time, others just visit the habitat and then go away again.

Look at this hedgerow habitat



Hawthorn bushes were planted to make a hedge a long time ago. Look how many different plants are growing there now. No-one planted them! All these plants grew from seeds. There are lots of different plants here so many animals come too. They find food in the hedge and a place to shelter and have their young. Many animals come to feed on the plants but some feed on the animals that come to the hedge.



1. Explain why lots of different plants grow in the hedge.
2. Write down five different animals living in the hedge. Next to each animal write down why it comes there.
3. Write down some animals that eat plants in the hedge. Write down some that eat other animals.
4. Write down what you think would happen to the animals if the hedge was cut down.

A place to live

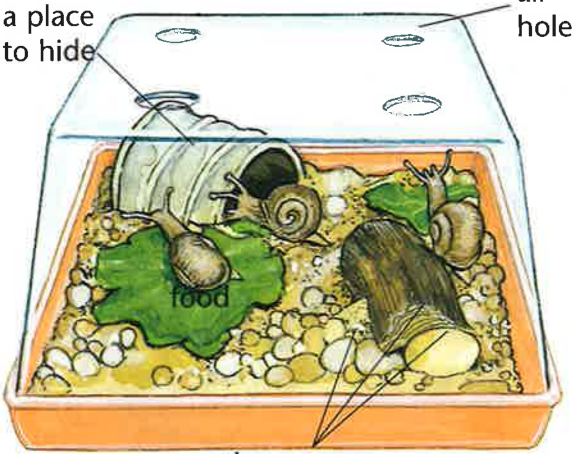
Different animals live in different places. They have to be able to find food and water. Many need air to breathe and they also need a place to hide from other animals that would eat them. Animals are especially suited to the place where they live.

What do snails like?

Tom and Clare looked for snails in the garden.

They found some hiding in a damp corner among the stones and logs.

They decided to keep some snails in the classroom to study them. The container they chose was a good place for the snails to live. This is called their **environment**.



▲ *A plant propagator has space for snails to move around.*

We cleaned the container out and gave the snails fresh food every day.

We made damp dark places for our snails to hide.

We took the snails back to their garden environment when we had finished studying them.

How do snails survive?

Snails are well suited to the environment where they live.

1 Explain what an environment is. Begin your sentence 'An environment is …'

2 Write a sentence describing what snails need in their environment.

3 Describe how the snail's body helps it to move over rough stones.

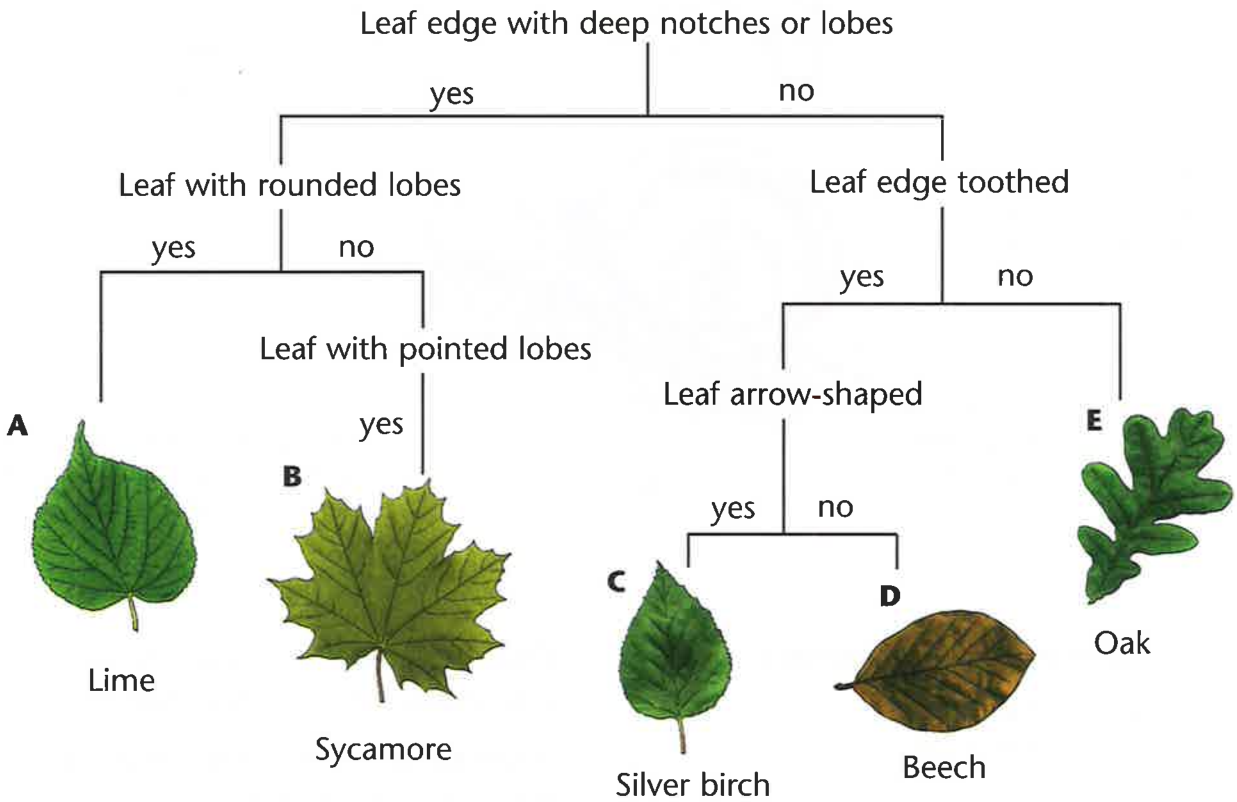
4 Write down three things snails can do to protect themselves.

Keys

Keys are used to tell us which plants and animals we are looking at. They can be branching or numbered keys. They start with a question to which the answer will be 'yes' or 'no'. This leads to more questions until you are left with the name of the plant or animal.

How do we use keys?

This leaf **key** is a branching key. Choose a leaf from the pictures below. Start by answering the top question in the key. Decide whether the answer is 'yes' or 'no', then follow the lines, answering each question until you come to the name of the leaf. Find out the name of each leaf using the key.

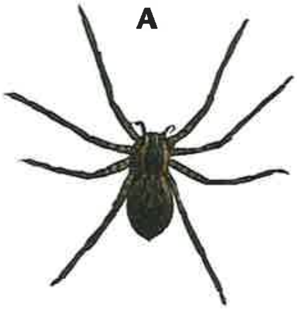


This key will only work for these five leaves. If you use it with a different leaf it would give you the wrong answer.

Using a key to identify some garden animals

This is a numbered key. It works like a branching key. Answer each question and go to the next number you are given. Use the key to identify the animals shown.

A



B

C

1 Does it have legs? ....go to 2
No legs? ....go to 4

2 Does it have 4 pairs of legs?...Spider
Does it have a lot of legs? ......go to 3

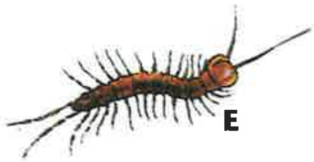
3 Has it a flattened body with one pair of legs on each segment?................................Centipede
Has it a cylindrical body with two pairs of legs on each segment?........................Millipede

4 Does it have a long, segmented body? ....Earthworm
Does it lack segments? ....go to 5

5 Does it have a shell? ....Snail
No shell?.................................Slug

D

E



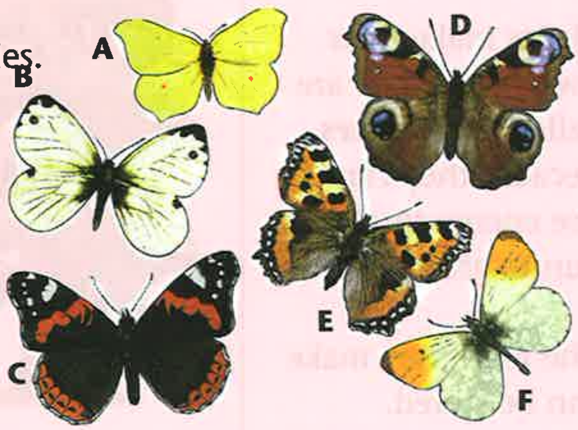
F

A numbered key is more useful if there are lots of different animals or plants to identify. A branching key would take up too much room.

1 Why do we use keys?

2 Use the key to identify these six butterflies.

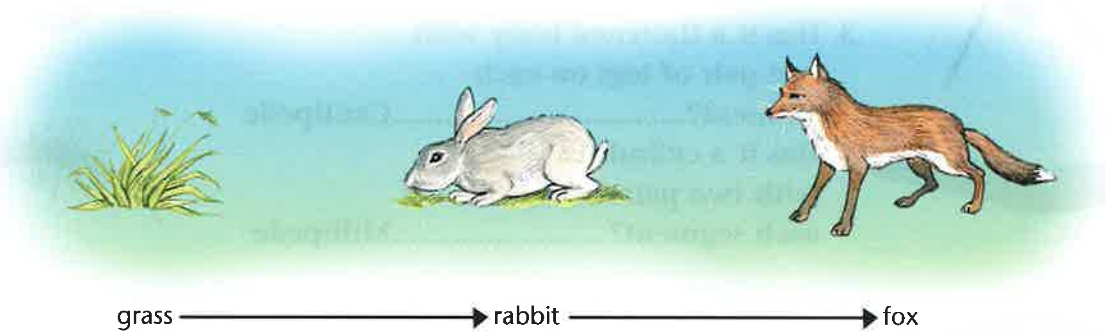
1 Butterfly mainly brown................go to 2
Butterfly not brown......................go to 4
2 Eye-like marks on wings ....Peacock
No eye-like marks on wings ....go to 3
3 Red bands and white patches on wings......................................Red admiral
Yellow patches on wings.............Tortoiseshell
4 Pale yellow wings ....Brimstone
Wings mainly white......................go to 5
5 Orange marks on wings ....Orange tip
Black marks on wings ....Cabbage white



Food chains

A food chain shows who eats what. Nearly all food chains start with a green plant. The animal that eats the plant is next in the chain and so on. The last animal in the food chain is the top carnivore.

What is in a food chain?

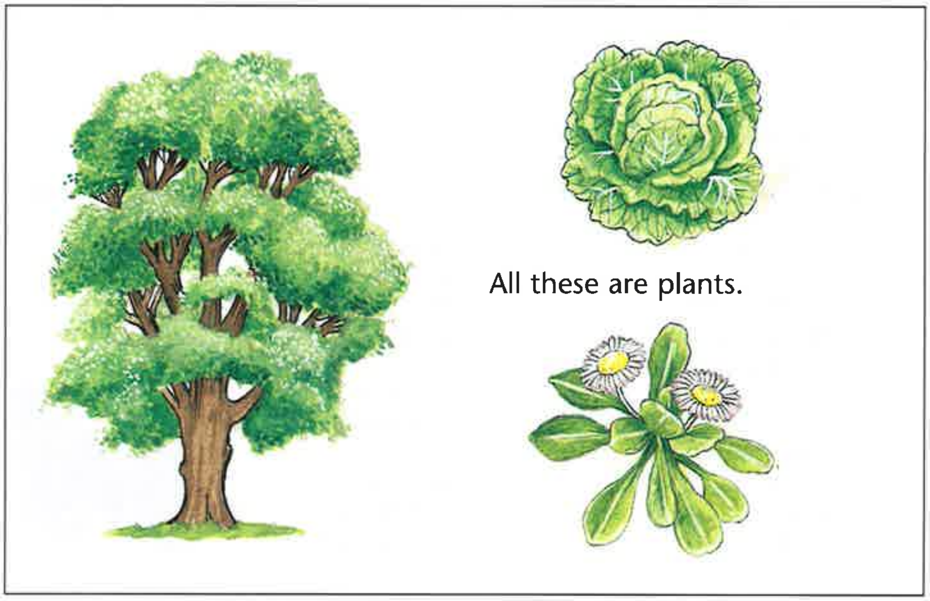


Look at the picture of the **food chain**. Look carefully at the direction of the arrows. They are *always* drawn in this direction. An arrow means 'is eaten by'. So the grass 'is eaten by' the rabbit which 'is eaten by' the fox.

How do plants feed?

Plants make their own food. They are called **producers** because they can use energy from the Sun to grow.

The food they make can be stored.

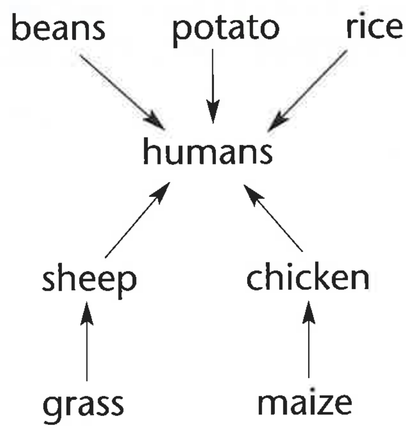


All these are plants.

Are we part of a food chain?

Humans eat many different plants and animals. We are omnivores.

These are all food chains with humans in them. All food that we eat starts from green plants.



What are predators?

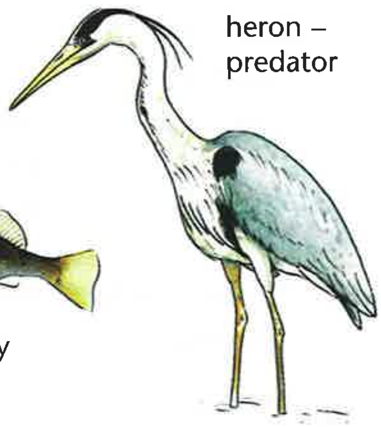
Predators are animals that hunt and feed on their **prey**. Many animals which are prey feed on green plants. For example, greenfly feed on the sap of plants and ladybirds feed on the greenfly. The greenfly are the prey and the ladybirds are the predators.

thrush – predator

snail – prey

fish – prey

heron – predator



1 Make two food chains from the list of animals and plants below.

cat dead leaves fox grass worm rabbit blackbird

2 Look at this food chain:

ash tree → greenfly → frog → snake

From the food chain give an example of a producer, a herbivore and a carnivore.

3 Why is the Sun important for all living things in a food chain?

4 In these pairs of animals decide which is the prey and which is the predator.

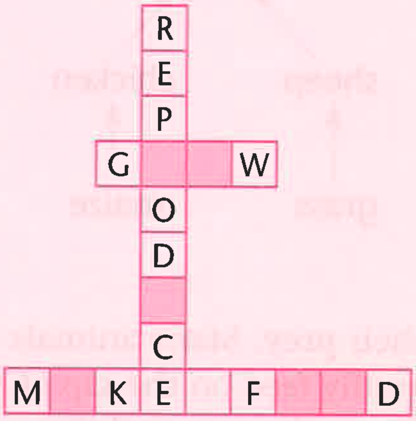
fish eating waterfleas

cat eating a mouse

fox eating a rabbit

Test your knowledge

1 Fill in the shaded boxes to make words that say what all plants do.



2 Copy these sentences then draw arrows to join them correctly. One has been done for you.

The flower	**takes in water.**
The stem	**helps to make the fruit.**
The root	**uses sunlight to make food.**
The green leaf	**has seeds inside.**
The fruit	**holds the plant up.**

3 Mina found this plant in the school cupboard after the holidays. What should she do to make it grow better?

4 Where do I live?

in a hedge	**in the pond**	**under a stone**

Write down these sentences and choose one of the boxes above to finish them.

a I have a long streamlined body, I have gills and fins, I have a strong tail for swimming. I live ....

b I have feathery wings, I eat fruit and berries with my strong beak, I need a safe place to build my nest. I live ....

c I eat rotting wood, I have to keep my body damp, I like cool, dark places. I need to hide from birds that would eat me. I live ....

5 Write down a food chain from one habitat you have studied. (Make sure you draw the arrows in the right direction.)

a For each of the living things you have named, write down whether it is a *producer* or a *consumer*.

b Write down the name of a *herbivore* in your food chain.

c Write down the name of the *top carnivore* in your food chain.

Materials and their properties

Before you start you should know:

- that materials can be grouped according to simple properties
- how to recognise and name some common materials
- that many materials have a variety of uses
- that some materials can be found naturally but others are man-made

At the start of this unit you will learn about some characteristics of materials and:

- how to identify a range of common materials
- that the same material can be used to make different things
- how to recognise several properties of the same materials
- that materials are suitable for making a particular object because of their properties
- how to test the properties of a material

Later in the unit you will learn about keeping warm and:

- how to use a thermometer
- what kinds of materials are good thermal insulators or good thermal conductors
- how we can keep hot things hot and cold things cold
- some everyday uses of thermal insulators and thermal conductors

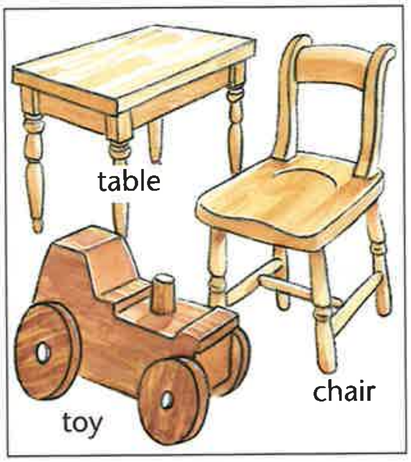
What things are made from

A material is the substance from which things are made. You use lots of materials every day. Materials have different properties. They might be soft, hard, waterproof, flexible or absorbent. These different properties mean that the materials are useful in different ways.

Different types of materials

You use many different objects both at home and at school, such as knives and forks, chairs and pencil cases, skipping ropes and balls. These objects can be made from metal, **wood**, glass, **plastic**, wool or other materials. The materials they are made from depends on what they are used for.

Paper towels can be used to soak up liquids in the kitchen. The paper is **absorbent**. Metal wire can be bent and twisted. It is **flexible**.



These objects are often made from wood. Wood has been used because:

- it is hard;
- it is strong;
- it is easy to shape.

These objects are often made of metal. Metal has been used because:

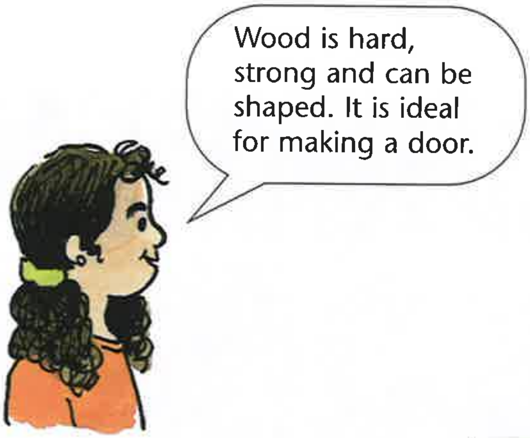
- it can be sharp;
- it doesn't burn;
- it is hard and strong.

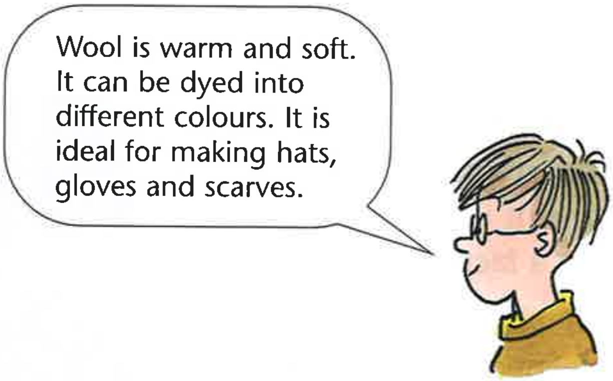
These objects have been made from plastic. Plastic has been used because:

- it is **waterproof**;
- it can be colourful;
- it can be **moulded** easily.

What are its properties?

Materials are used for different things because of their **properties**. A window is made from glass because glass can let light into a room. One of the useful properties of glass is that it is **transparent**.



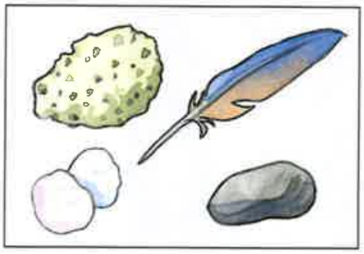


Yasmin collected some objects from home and school. She grouped them using the properties of hard and soft.

She could also have grouped them using the properties of **shiny** and **dull**.


hard


soft


dull


shiny

1 Make a list of ten objects that you use every day.
Write down next to each object in your list what it is made from.
For example,
chair wood

2 Find two different ways to sort the objects in your list using properties. For example, hard and soft or rough and smooth.

Where materials come from

Natural or raw materials come from animals, plants or under the ground. Wood can be used in its natural state to make things like lolly sticks or clothes pegs. Wood can also be changed or manufactured to make new products like paper.

Materials from plants

Cotton grows on bushes. When it is ripe it is harvested and sent to a factory.

In the factory the cotton bolls are cleaned and spun into long threads of cotton. The threads can be woven to make cotton fabric which is used to make clothes.

▲ *The cotton bolls being harvested.*

Rubber comes from the sap of the rubber tree. The sap is collected and processed into rubber which can be used for tyres and elastic bands.

Paper is made from wood. After the trees have been cut down they are taken to the mill and **manufactured** into paper.

◀ *The sap being collected from a rubber tree.*

Materials from animals

Silk is made by silk moths when they spin their cocoon. Silk is a fine fibre or thread which can be woven into fabric.

Leather, suede, wool and fur come from the skins of animals. The skins are processed and turned into clothing.

▲ *The cocoon of the silk moth.*

▲ *Some of the animals from which leather, suede and wool come.*

Materials from under the ground

Iron ore is a mineral that is found in rocks under the ground. It is mined and manufactured into metal products such as nails, screws and garden tools.

Slate, flint, clay and coal are other materials that come from the ground.

▲ *Iron ore being mined.*

1. Write a list of five materials that come from plants.
2. Draw your shoe and label the raw materials used to make it.
3. Write a list of five objects that can be manufactured from wood.

Finding out about useful properties

Only certain materials will be suitable for making a particular object. Tests have to be carried out on materials to find out which one does the job best. Usually more than one property will be needed for the object but some properties are more important than others.

What are useful properties?

Hardness, softness, smoothness, roughness, colour, smell, brittleness, conducting and insulating are all **properties** of materials. Every material has its own special set of properties.

A table is often made from wood because it has many useful properties.

Wood is a very strong material. This means it is ideal for making a table which might have to hold a heavy weight.

The surface can be made very smooth. If the surface is polished it can make the wood very attractive. Different kinds of wood are different colours and have different patterns of grain. These can also be used to make things from wood that are attractive to look at.

What would we test?

This table needs to be strong to carry a heavy weight. For this table, this is the most important property. Some woods are stronger than others. Tests are carried out to choose the strongest wood to use for the table, even though it may not be the most attractive.

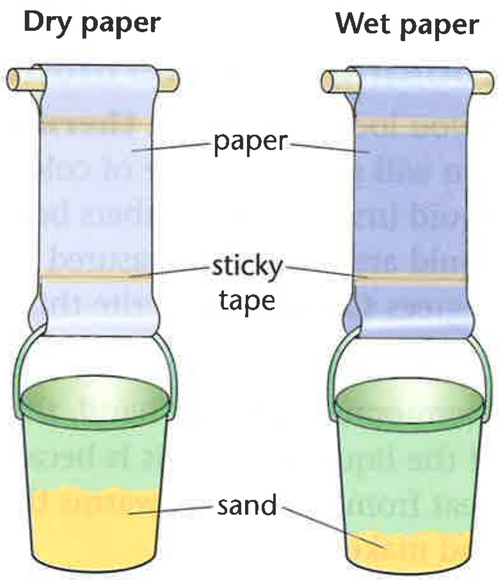
What is the best paper to use?

Yasmin sent a parcel to her friend in India. Her friend told her that when it arrived the paper had fallen apart and most of the items were missing. She believed that the damage was caused because the parcel had got wet. Yasmin decided she would carry out some tests on different types of paper before she sent another parcel.

Yasmin's test

Yasmin chose four different wrapping papers and labelled them A, B, C and D. She cut short strips from each type of paper and, one at a time, attached a container to one end of the paper strip.

She added sand until the paper broke. She then weighed the amount of sand and put her results into a table. She repeated her experiment but this time she soaked each paper strip in water.



Yasmin's results

	Dry	Wet
paper A	95g	50g
paper B	120g	80g
paper C	60g	20g
paper D	130g	60g

1. Put Yasmin's results into a bar chart.
2. What did Yasmin have to do to make sure her test was fair?
3. Which paper would be the most useful for her to use for the parcel? Why have you chosen this one?
4. Which paper would be of no use? Explain why not.
5. Can you suggest how Yasmin could make her investigation better?

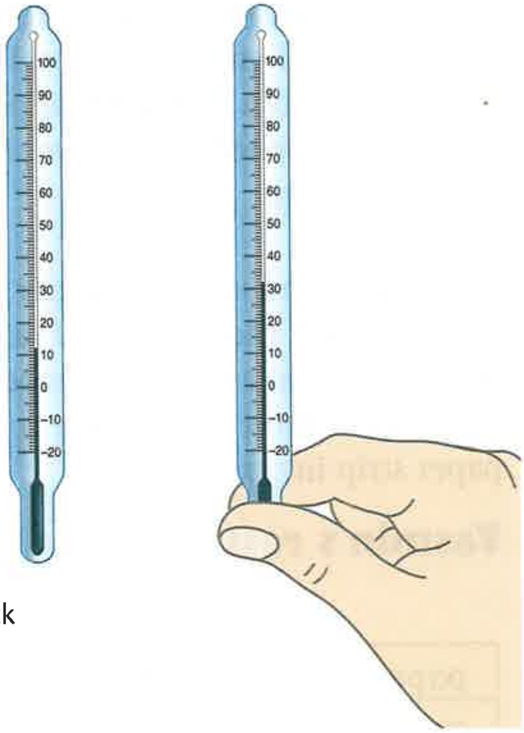
Thermometers

Thermometers can be used to measure the temperature of solids, liquids or gases. The liquid in the thermometer rises as it gets warmer. The number of degrees Celsius (°C) will be higher as it gets warmer and lower as it gets colder.

Looking at a thermometer

If you look closely at a **thermometer** you will see a thin line of coloured liquid inside. The numbers beside the liquid are the scale measured in degrees **Celsius**. We write this °C.

If you hold the bulb end of the thermometer in your hand, the level of the liquid rises. This is because the heat from your hand warms the liquid and makes it rise.



Clare's teacher showed the class some thermometers.

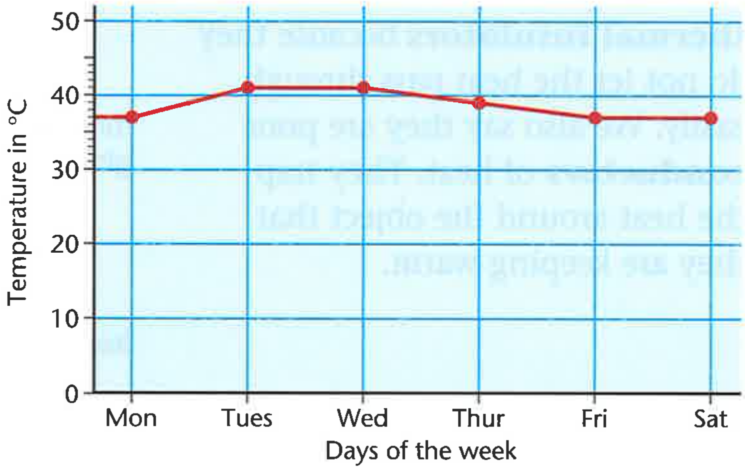
Using a thermometer to record temperature

Clare used a thermometer to measure the temperature of the air in different parts of her school. She made sure that she waited for the liquid inside the thermometer to stop rising or falling before she wrote down the temperatures. She put the results in a table.

Part of school	Temperature
Clare's classroom	22 °C
cloakroom	20 °C
stock cupboard	19 °C
near the radiator	30 °C
in the fridge	4 °C
playground	8 °C

When Clare had chicken pox her mum kept a chart of Clare's temperature each day.

Clare started to feel ill on Tuesday when her temperature began to rise.



▲ *Line graph.*

1 Explain in your own words how a thermometer works.

2 Draw a bar chart to show the temperatures in the different parts of Clare's school. Which part was warmest? Which part was coldest?

3 Why were each of the temperatures in Clare's school different?

4 Look at the line graph of Clare's daily temperatures and answer these questions.

a What is Clare's normal body temperature?

b What was Clare's highest temperature when she was ill?

c How long was Clare's temperature above normal?

Keeping things hot or cold

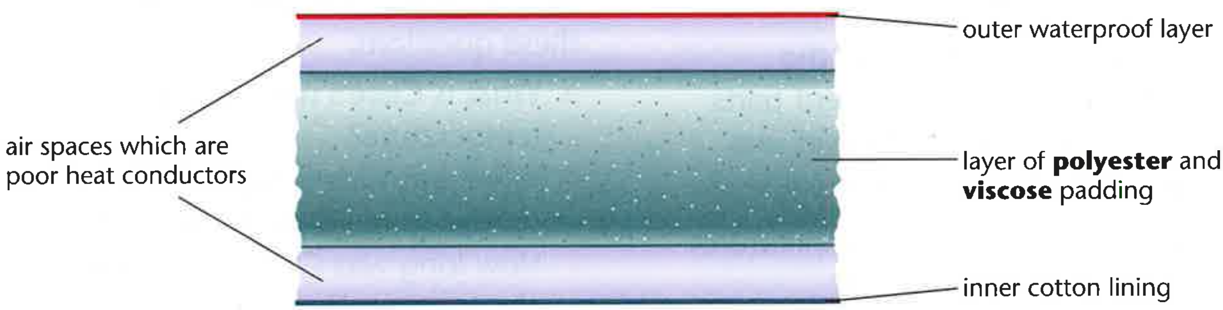
Materials which are used to keep things hot or cold are called thermal insulators. Heat cannot easily pass through layers of thermal insulation. A hot substance which is insulated will stay hot. A cold substance which is insulated stays cold because the insulation keeps the heat out.

Keeping things hot

Some materials are good for keeping the heat in. We use fabrics like these for our winter clothing.

These materials are called **thermal insulators** because they do not let the heat pass through easily. We also say they are poor **conductors** of heat. They trap the heat around the object that they are keeping warm.

Sometimes layers of material are used to keep things warm. These layers work well because air is trapped between each layer. Air is a poor conductor of heat and so the layers **insulate** the object.

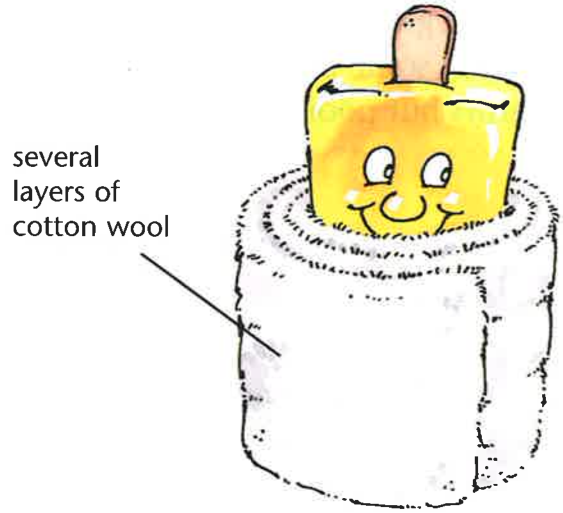


▲ *The layers and air spaces in a ski jacket which is a good thermal insulator.*

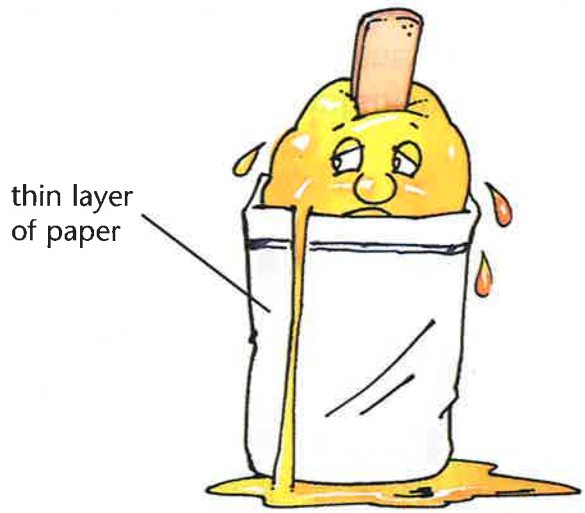
Keeping things cold

Thermal insulators are also good for keeping things cold. This is useful when we want to stop frozen things from melting. If we leave them in a warm place, they will get hotter.

An ice lolly wrapped in a thick layer of a thermal insulator (or lots of thin layers) will stay frozen for quite a long time because the insulation keeps the heat around it out.



An ice lolly which is not wrapped in a thermal insulator will quickly melt because the heat around it can get in.



Remember that heat travels. Thermal insulators stop this happening by stopping the heat escaping or entering.

1. Why are fish and chips wrapped in layers of paper?
2. Why are layers of thermal insulation better than one layer?
3. Why does a wrapped ice lolly stay cold longer than one which is not wrapped?

Insulators and conductors

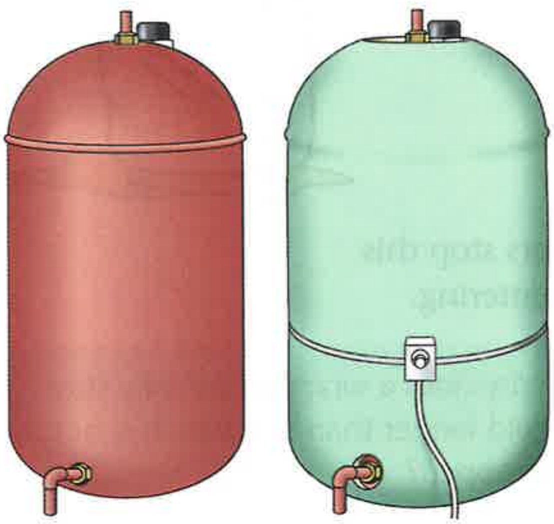
Sometimes we need to use a material which is a good thermal conductor. At other times a good thermal insulator is needed. Metals are good thermal conductors and poor thermal insulators. Wood and some plastics are the opposite, they are good thermal insulators but poor thermal conductors.

When do we need a good insulator?

Metals are good thermal conductors. The heat from the saucepan moves quickly through the metal handle so it gets very hot.

Plastic or wood make better saucepan handles because they don't let heat through them quickly.

Hot water tank



A water tank is usually made of metal because it is waterproof and strong. Metal is a good thermal conductor so it will also cool down very quickly.

It costs money to heat water, so we want the water to stay hot as long as possible. We usually put a very thick jacket around the tank. The jacket is a good thermal insulator. This keeps the heat in and the water stays hotter for longer.

When do we need a good conductor?

Many people have radiators to heat their homes. Some radiators have hot water moving through them. The radiators are made of metal which conducts heat well. The heat from the water can get quickly to the outside of the radiator so that it can heat the room.

Irons

Irons have metal bases which get hot. They usually have plastic handles so that your hand stays cool.

The base of the iron needs to be a good conductor so that heat can get to the clothes to smooth them.

1 Why does the iron have a plastic handle?

2 For each of the objects state whether it needs to be a good thermal conductor, or a good thermal insulator.

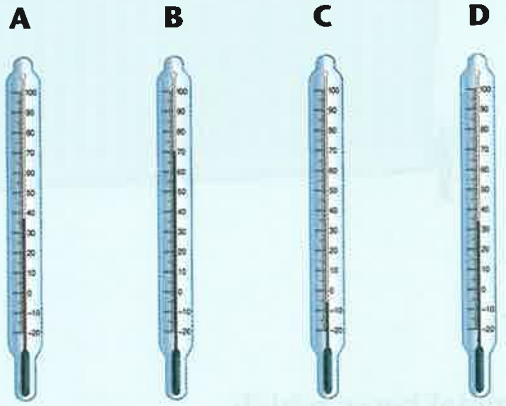
tea cosy, table mat, plate warmer, gloves, thermometer

3 Daniel has three spoons: a metal one, a wooden one and a plastic one. He wants to find out which one would be the best for stirring a hot drink without burning his fingers.

Design a fair test which he could carry out to find out the answer.

Test your knowledge

1 Read the temperature on each of the four thermometers below. Match each temperature to the place where the temperature was recorded.



a freezer
on a radiator
a cup of tea
a healthy human

2 Design a container that will stop ice lollies melting on a picnic.

Draw your container and label the materials you would use. Explain how your container would work.

3 Why was the material chosen to make each of these objects? Copy out the table and fill in your reasons.

Object	Material	Reason
water bottle	plastic	
window	glass	
garden spade	metal	
jumper	wool	

4 Make up a game to identify materials by describing their properties.

Do this by making up cards with the name of the material at the top and writing five properties of the material in a list. To play the game you have to guess the material from the properties. You score ten marks if you guess the material when you have been given one property, eight marks if you are given two properties and so on. Play the game with a friend and see who scores most points.

Solids, liquids and mixtures

Before you start you should know that:

- rocks are found in nature
- solids have properties in common and melt to form a liquid
- liquids have properties in common and freeze to form a solid
- a mixture is made of two or more materials

At the start of the unit you will learn about rocks and soils and that:

- rocks are found sticking out of the Earth's surface or lie beneath the sea or soil
- different rocks are used for different purposes
- soils come from rocks and also contain humus
- different soils contain rock particles of different sizes
- water drains through different soils at different rates

Later in the unit you will learn more about solids and liquids, how they can be mixed and separated and:

- the names of lots of solids and liquids
- what kind of properties a solid or a liquid has
- that a measuring cylinder is used to measure the volume of a liquid in cm^3
- more about melting and freezing
- what can happen when you add different materials to water
- how sieves help separate two or more solids from each other
- how to use a filter to separate an undissolved solid from a liquid
- how you might separate a more complicated mixture

Rocks and soils

Rocks are found everywhere, such as on mountains, cliff faces and buried beneath the soil. Different rocks have different properties. These will affect how they are used. Soil is mainly made from broken down rocks. Different kinds of soil are made from different kinds of rock.

Where do rocks come from?

Rocks were made a long time ago. There are many different kinds of rock. They come in many different colours, textures and shapes. Some are easily worn away. Other rocks are very hard.

Chalk is soft and crumbly. It was made from millions of seashells of tiny sea creatures which have been crushed together.

This hard, shiny rock is called granite. It was made when red hot, liquid rock cooled down below the Earth's surface.

Sandstone was originally formed in a hot desert from grains of **sand**, which were pressed hard together.

How are rocks used?

Rocks are used to make many useful materials. Each type of rock has its own set of properties.

Rocks are chosen to do a particular job because of their properties.

Look at how the rocks have been used in this church. Why has each one been chosen?

What does soil contain?

Soil is made when rocks are broken down into very tiny pieces. There are many different kinds of soil. Each one contains a mixture of different sizes of particles.

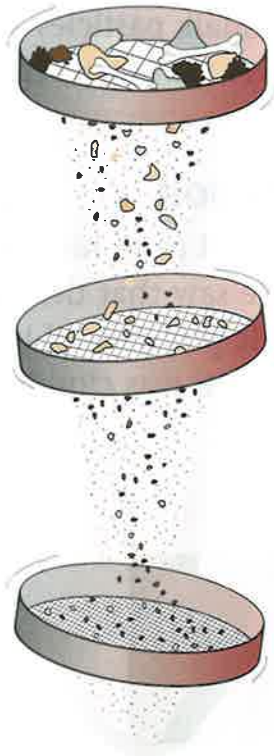
Soil can contain large particles and small stones. If most of the soil is like this it is often called a sandy soil.

Soil can also contain many small particles of broken down rock. If the soil is mostly like this it is called a **clay** soil.

Many soils also contain small pieces of dead animals, plants and animal dung. This is called **humus**.

Microbes break up the humus and release nutrients that help plants grow. Humus also helps keep a soil moist.

Some animals, like worms, use humus as food. They also make the texture of soil better by leaving tunnels that let air and water into the soil.



▲ *If you **sieve** a soil you can find out what it contains.*

1 Think about where rocks are used. Copy a table like this one into your book. Fill in the table with as many rocks as you can find.

Name of the rock	Where is it used?	Why is it used there?

2 Find out the best type of soil for growing carrots. Find out some reasons why this type of soil is best. Predict what might happen if you use a different soil. Write your answers in complete sentences, using some good scientific words.

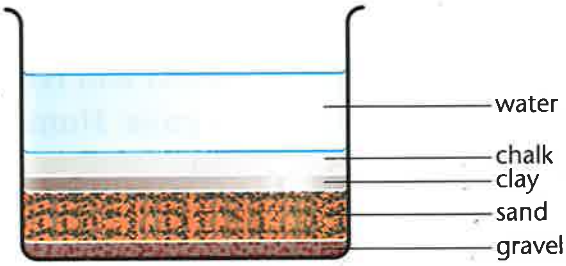
More about soil

Soil is made when rocks are worn down. It is made of particles of different sizes. Clay particles are very fine and get sticky when they are wet. Chalk particles are also fine but do not become sticky when wet. Sand particles are bigger and gritty.

Looking at soil

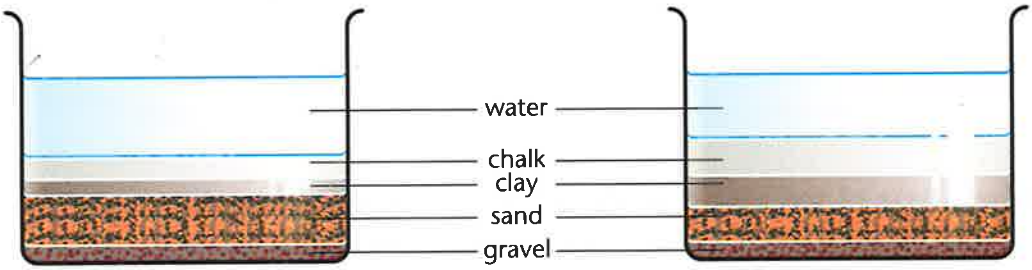
Jack got some soil from his garden. He used a hand lens to look at it closely. He saw that the particles were different sizes, shapes and colours. He put the soil in a bottle with some water and shook it. At first it was cloudy. The next day he could see different layers.

▲ *Soil and water shaken together.*



▲ *Soil and water once they have settled.*

Jack went to stay with his grandfather. He wanted to see if the soil there was the same as in his own garden. Jack found that the thickness of each layer was different from his soil. His grandfather's soil had a thinner layer of **sand** and more **clay** and **chalk** than Jack's soil.

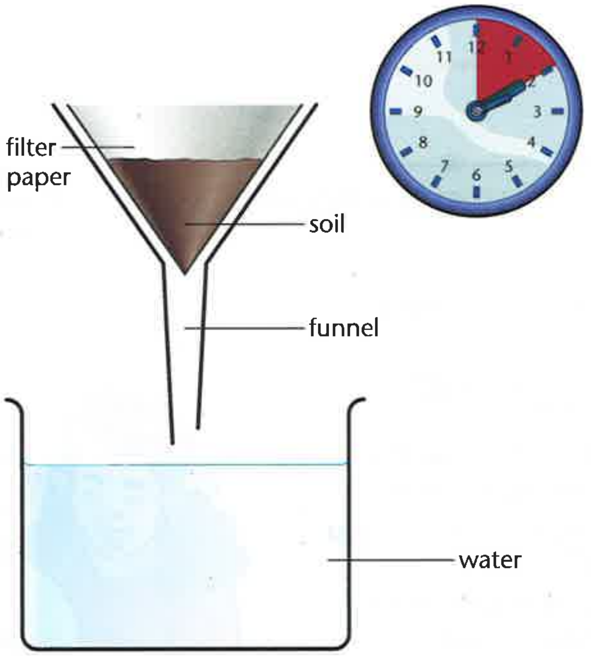


▲ *Jack's soil sample.*

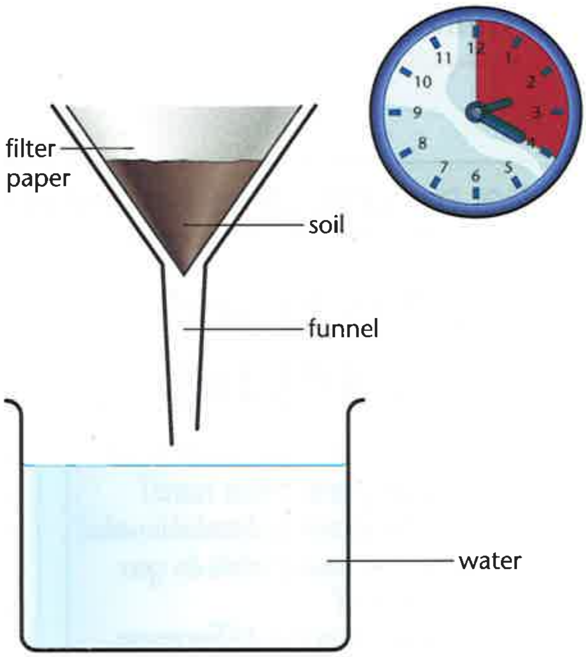
▲ *Grandfather's soil sample.*

Soil drainage

Jack tested the two soils to see which would let water run through the fastest. His grandfather said that this was called testing soil drainage. Jack put the same amount of each soil into different funnels and poured 100 ml of water into each one.



▲ *Jack's garden soil let the water through quickly.*



▲ *His grandfather's soil let the water through much more slowly.*

Jack's soil had less clay and more sand than his grandfather's. Sand particles are bigger and have more air spaces between them. The air spaces let the water drain through more quickly.

Grandfather's soil had a lot of clay which is made from very fine particles. The water could only drain through it slowly as there were smaller air spaces between the particles.

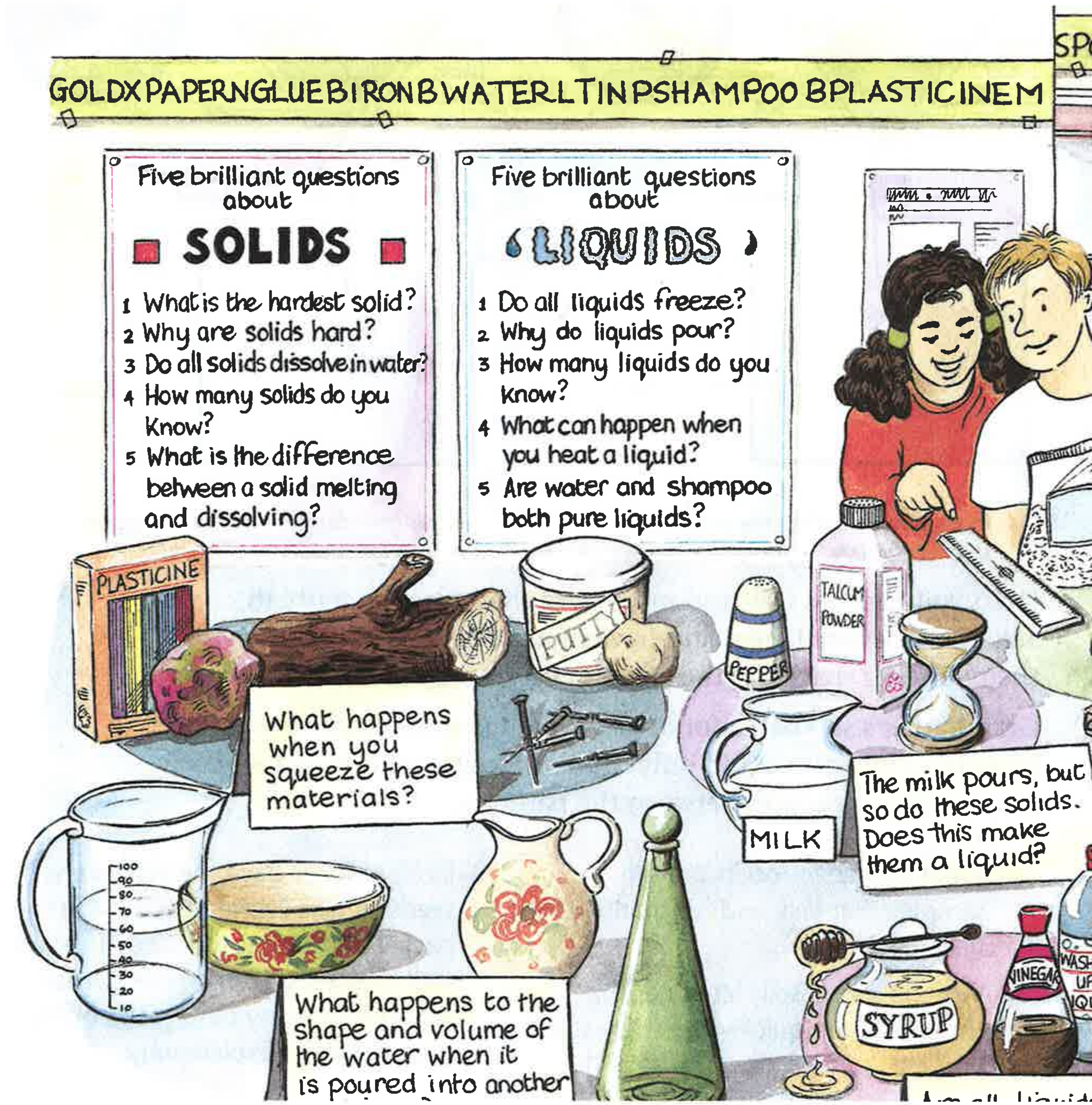
1 What can be found in the soil samples that Jack and his grandfather tested?

2 Why do sandy soils let water run through more quickly than clay soils?

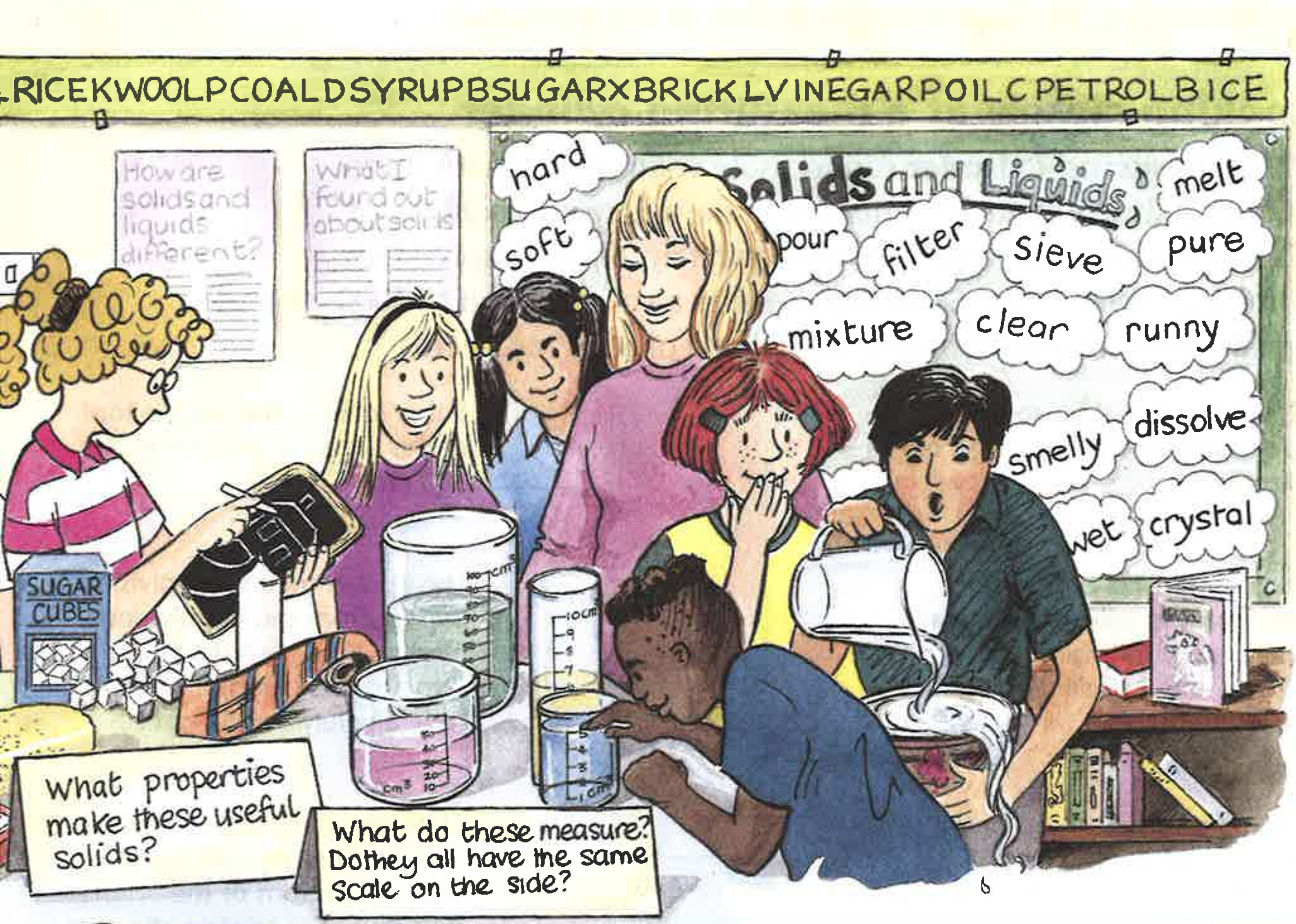
3 Jack's teacher gave the class some seeds to take home to grow. On the packet it said that the seeds needed well-drained soil. In whose garden would they grow best, Jack's or his grandfather's? Explain why.

Solids and liquids

Most materials are either a solid or a liquid. Solids keep their shape and only go out of shape if you give them a strong push or pull. Liquids are runny, can be poured and take up the shape of the container they are in.



Class 4T have done a lot of work about **solids** and **liquids**. They have thought about the solids and liquids they use every day, what they look like and what they can do. Miss Taylor, their teacher, has shown them some new ones. They have learnt a lot about how makes solids differ from liquids. Look closely at the display they have made for you.



1 Find the names of all the materials that are in the word strip which goes around the wall. Sort them into solids and liquids. Add some more of your own.

2 Look at the materials on the table. Use them to answer the six questions Class 4T have written for you.

3 Class 4T have written some brilliant questions on the wall. Use your school library to find out the answers.

4 Make up another five brilliant questions that you would like the answers to. Ask your friends to write the answers for you.

Measuring volumes of liquids

Measuring cylinders are used to measure the volume of a liquid. The scale marked on the side measures the volume in the correct units of cm^3. Measuring cylinders come in different sizes. The volume of a liquid stays the same when it is poured into different containers but its shape changes to that of the container.

Looking closely at a measuring cylinder

This **measuring cylinder** can measure volumes of liquids up to 100 cm^3. Always write the units of volume as cm^3 and not Cm^3 or CM^3. It measures the volume fairly accurately. Measuring cylinders come in different sizes. Some can measure a volume of up to 1000 cm^3. Smaller ones measure a maximum volume of 5 cm^3 or 10 cm^3.

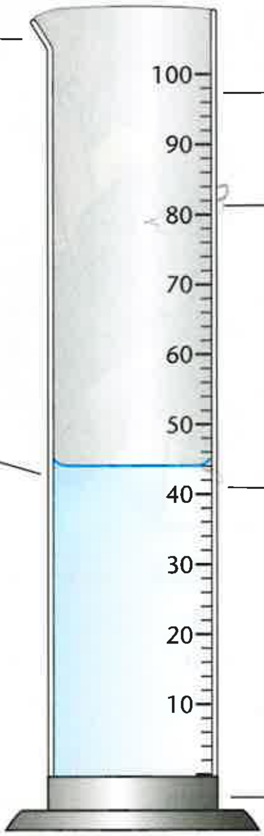
There is a special lip so that the liquid pours without spilling out everywhere.

There are marks on the side. Each mark is called a **division**. There is a big division every 10 cm^3 and a small division every 2 cm^3.

Look carefully! The top of the liquid is not exactly level. It curves downwards. This is called a **meniscus**.

Some measuring cylinders are made of a clear plastic. Others are made of special glass. The plastic ones are harder to break but are not as easy to read accurately.

The cylinder has a wide base to stop it falling over easily.



If the liquid comes to the top of this scale the volume is 100 cm^3.

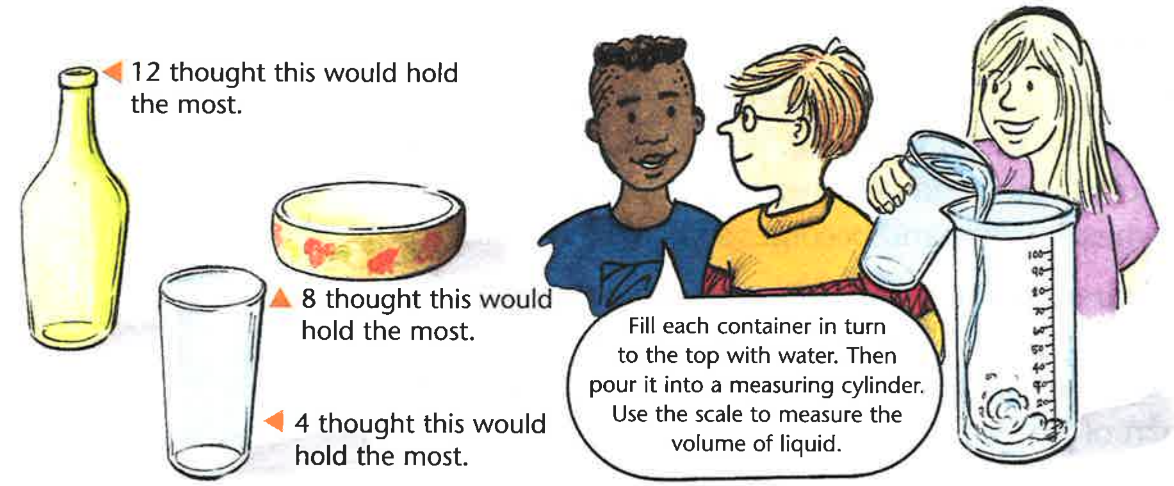
This spot is on a small division, two up from the big division marked 80 cm^3. If the liquid came to this height it would have a volume of 84 cm^3.

Clare measures the volume by making sure her eyes are level with the bottom of the meniscus. The reading she sees is 44 cm^3.

The bottom of the scale starts at 0 cm^3.

Is it magic?

Miss Taylor showed Class 4T three containers that looked quite different. First of all she asked them to predict how much each would contain when it is completely full. She wanted them to carry out a scientific test to see if their predictions were any good and then write up their work for homework. Here is what they did. Think about each step very carefully.



1 Your pen friend who lives abroad has not seen a measuring cylinder before. Write a letter to tell them what it looks like and how it is used to measure volumes.

2 Imagine you had been Clare in Class 4T. Write up what you did in a scientific way for homework.

Melting and freezing

Melting and freezing are reversible processes. When a material melts it changes state from a solid to a liquid – ice melts to become water. When a material freezes it changes state from a liquid to a solid – water freezes to become ice.

Melting

When a solid is heated it **changes state** and becomes a liquid. This process is called **melting**. When the heat is removed, the liquid cools down and becomes solid again. For example, wax melts when it is hot and becomes solid again when it cools.

The children in Clare's class were making some chocolate shapes for the school fair. Clare broke a bar of chocolate into pieces. Then she melted it gently in an ovenproof dish that she put in a pan of hot water.

Clare poured the melted chocolate into a mould and left it to cool. The chocolate became solid again but had a new shape!

She knew that although the shape had changed, the amount of chocolate was the same.

Freezing

Freezing makes a liquid change state into a solid. Water freezes at a temperature of **zero** degrees Celsius (0 °C). Other liquids freeze at a different temperature to this.

The children in Clare's class were also making iced drinks to sell at the fair. They wanted to make different shapes and **flavours** of ice. They used orange juice, lemon squash, milk and cola. They poured the liquids into fruit-shaped moulds and left them in the freezer overnight.

Clare wondered if she could make a material freeze without putting it somewhere very cold. Her teacher lit a candle and they watched the wax carefully.

As the wax was heated it melted and became a liquid that ran down the candle. As the wax cooled it became a solid again. This showed Clare that wax freezes as it cools, without being in a very cold place.

1 Write down two processes that can be reversed.

2 Why does wax set on the side of a candle? Draw pictures and label them to show what happens.

3 Describe how you can make a solid melt.

Mixing materials

Mixing materials can make them change. Some changes are reversible. This means that you can get back the materials you started with. Some changes are irreversible. This means that you cannot get back the materials that you started with.

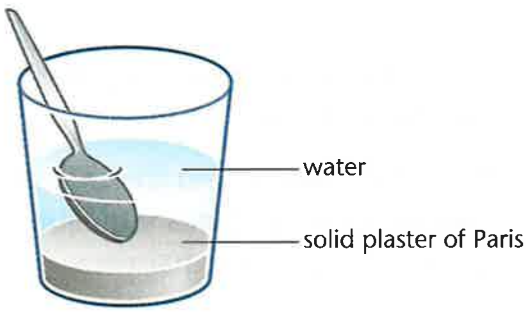
Looking at powders

Tom collected some powders – flour, cocoa, salt, sand and plaster of Paris. He looked at each powder with a hand lens. He saw that they were different colours and that the grains were of different sizes. The flour was very fine and the sand was coarse.

Tom wanted to see what would happen to each of his powders if he mixed them with water. He stirred half a teaspoon of each powder into different containers of water. He saw that some materials disappeared, or sank, or floated and some changed the colour of the water.

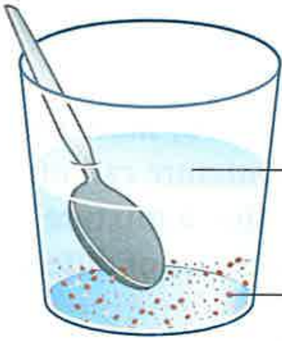
Irreversible changes

Tom saw that the plaster of Paris had sunk to the bottom of the container and had become solid. His teacher said that the powder had been chemically changed and could not be turned back to powder. The change was **irreversible**.



Reversible changes

Tom looked at the sand and water mixture with his hand lens. The grains had settled at the bottom of the container. His teacher said that he could separate the sand and water by **filtering**.



Tom looked at the salt water solution. He could not see the salt grains – they had dissolved. Tom left some of the mixture in a warm place. A week later the water had gone but the salt grains were back!

The change was **reversible**.

The flour and the cocoa powder changed the colour of the water. They had formed a **suspension**. The next day the flour grains and the cocoa grains had settled at the bottom of their containers. They had not dissolved.


flour held in suspension


cocoa held in suspension

1 Why couldn't Tom get his powdered plaster of Paris back?

2 Which of his materials would he be able to get back in their powdered form?

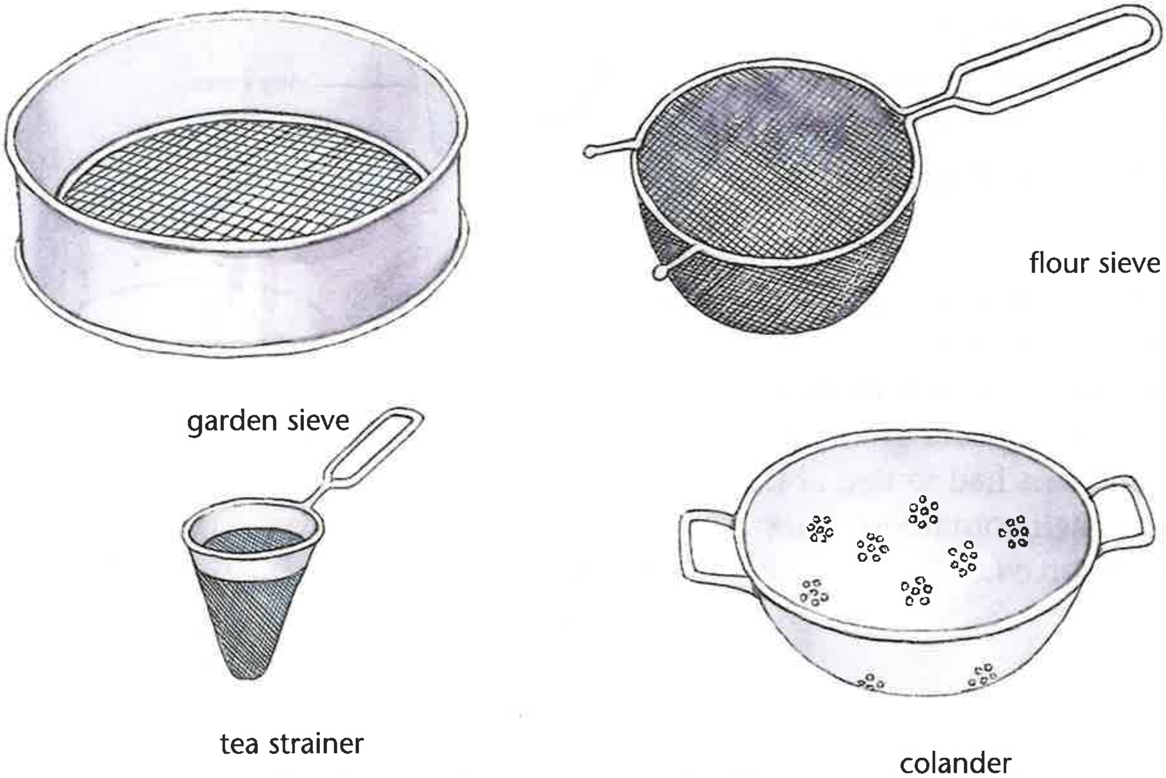
3 Which of these form a suspension and which make a solution – sand, flour, salt, cocoa and plaster of Paris?

Sieving

A mixture is made when two or more substances are added together. Substances in a mixture can often be separated easily. Sieving is a way of separating a mixture of two or more dry substances which have particles of different sizes.

Sieves

Sieves are often used in the home. For instance, sieves can be used to separate the lumps from the flour when making cakes. They can also be used in the garden to separate stones from soil to make it easier for seeds to grow.



▲Sieves have holes of different sizes to suit their purpose.

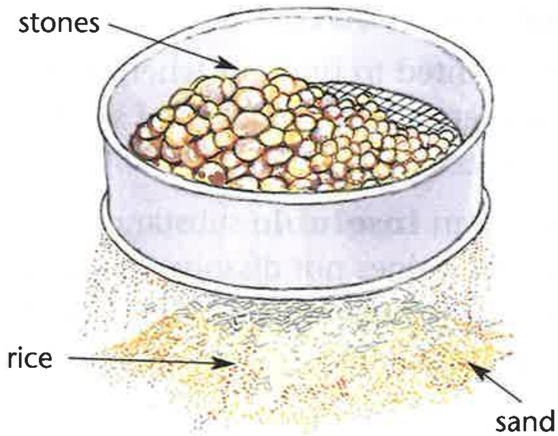
If a sieve has large holes it will stop large particles but anything smaller will fall through.

If a sieve has tiny holes it will let only very small particles fall through. Bigger lumps will be trapped in the sieve.

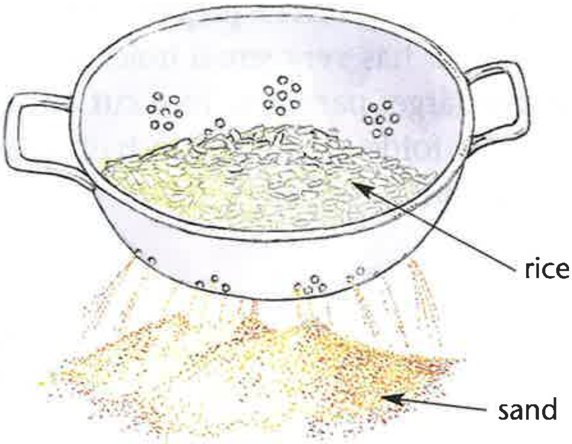
Separating a mixture of solids

Sara's teacher noticed that the jars of rice, sand and stones that the class used for science had tipped over. She gave Sara the **mixture** and asked her to separate the three substances. As the mixture was made up of dry particles, Sara chose two different sieves to help her with the task.

She chose to use a **sieve** with large holes first. This let through the rice and sand but trapped the stones.



Her second choice was a sieve with medium-sized holes. This one trapped the rice but let the fine particles of sand pass through.



Using the process of sieving, Sara successfully separated the mixture of dry substances for her teacher.

1. What is a mixture?
2. What is the purpose of each of the four sieves on page 68?
3. How would you separate a mixture of sugar, rice and pasta bows??

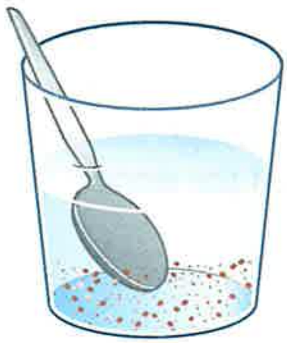
Filtering

Solids that do not dissolve in a liquid are insoluble substances. These may sink to the bottom or stay in suspension in the water. Insoluble substances can be separated from liquids by filtering.

Making a filter

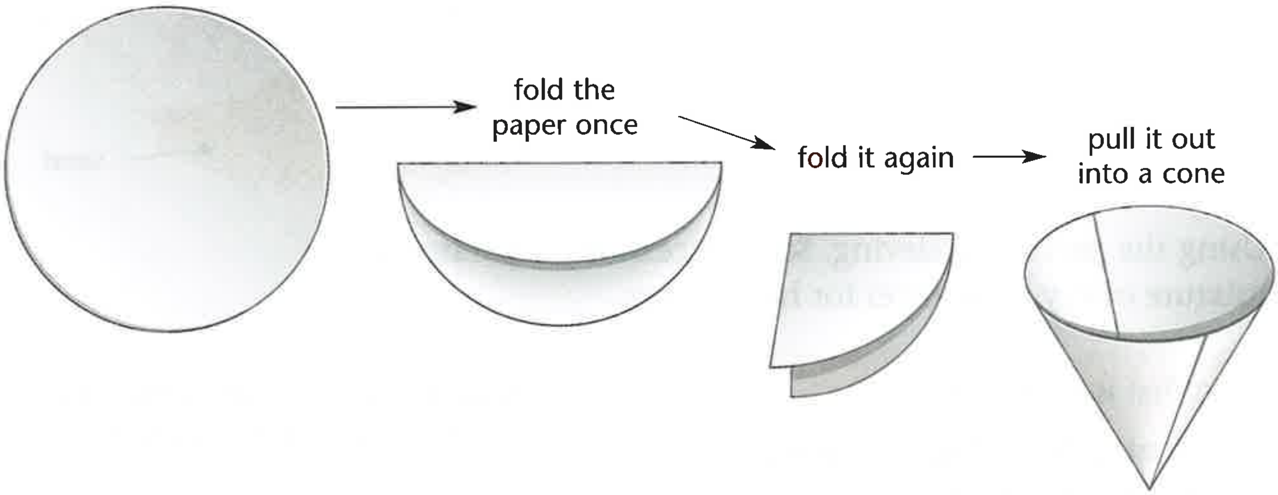
Tom wanted to find out whether he could separate his mixture of sand and water.

Sand is an **insoluble** substance because it does not dissolve in water. The grains had settled at the bottom of the container.



▲ *Mixture of sand and water.*

Tom used some **filter paper** and a funnel to **filter** his mixture. Filter paper has very small holes which let tiny particles through but trap larger particles. Tom cut out a circle from the filter paper. He folded the circle in half, and then in half again to make a cone.



▲ *Making a filter.*

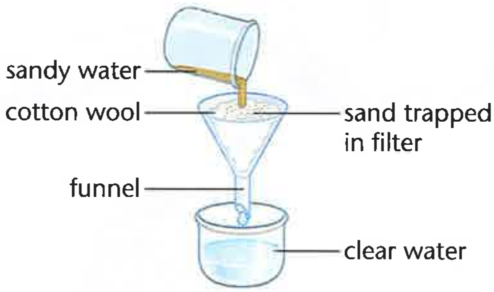
Using a filter

Tom opened the cone so that it fitted inside the funnel. He put the funnel over a container. Then he carefully poured the sand mixture into the filter paper cone. Tom watched as the water dripped through the tiny holes in the filter paper into the container.

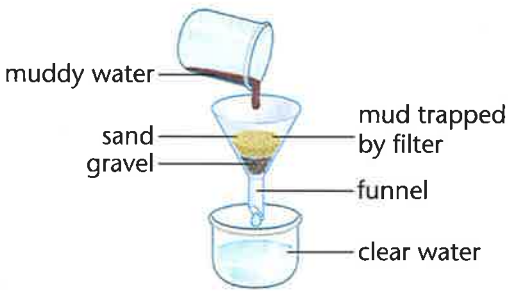
Filtering the sand from the water.

Tom's mixture had been separated by the filter. The water went through the paper into the container and the sand was trapped in the filter paper. Tom carefully removed the filter paper which held the sand and left it to dry.

Tom used up all the filter paper so he looked for other materials to use as filters. He tried cotton wool, gravel and sand. He found that these materials could also separate his insoluble substances by trapping the particles.



Cotton wool filter.



Sand and gravel filter.

1 What did Tom's mixture contain at the start?

2 What was trapped in the filter paper?

3 What passed through the filter paper?

4 Do you think the other materials Tom used as filters were better or worse than the filter paper? Explain why you think this.

Separating mixtures

A mixture is made up of two or more substances which are not joined together. These can be separated easily. The best way of separating the substances depends on their properties.

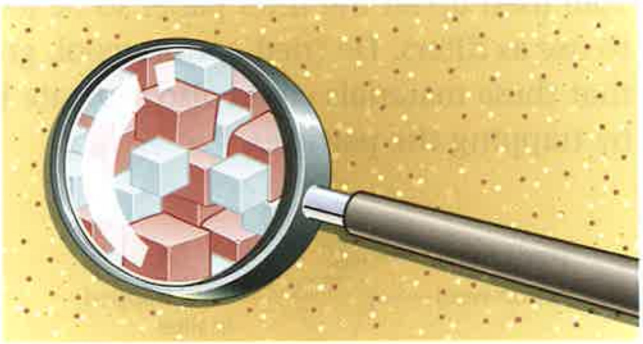
How can you separate two solids?

Clare has a mixture of broad bean seeds and runner bean seeds in a jar. Both kinds of seed are large. It is easy to tell the difference between them because they are different shapes.

The quickest way to sort them is by hand. Clare looks for the broad bean seeds and picks them out one by one. This takes a long time.

You can do the same thing to separate a mixture of two solids.

Clare looked carefully at a mixture of sand and salt. A magnifying glass helped her see the two different kinds of particles. She used tweezers to help separate them but this took a long time.



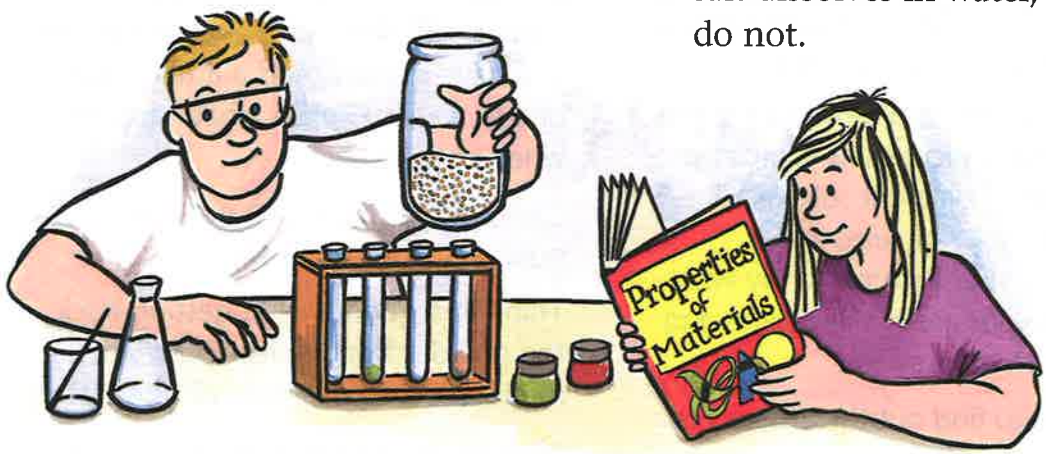
Clare found that she could separate them quicker by using a sieve. But this method did not work well as some fine sand grains went through too.

Separating more complex mixtures

Matthew has been using his chemistry set. By accident he makes a mixture of sand, salt and small pieces of iron. He wants to separate the mixture but is not sure where to start.

He asks Clare for help. She says they must think about the properties of the materials. Here are their ideas:

- iron is magnetic, the other two materials are not;
- salt dissolves in water, the other two do not.



Matthew decides that he should treat the mixture in the following way.

(1) Use a magnet to separate the iron filings from the mixture.

(2) Then add water to dissolve the salt.

(3) Next use filter paper or a sieve to separate the sand.

(4) Finally boil off water to leave the pure salt behind.

His method works well.

1. In what ways are a sieve and filter paper similar? In what ways are they different?
2. Draw the equipment Matthew will use to separate his mixture at each of the four stages. Show how it should be used.
3. Think of a better way that Clare could have separated the sand and salt mixture. Describe how you would do this.
4. Describe how you could separate mixtures of:
   - a peas and sand;
   - b sugar and sand;
   - c salt and chalk.

Test your knowledge

1 Sort out these materials into solids and liquids.

wood	**oil**	**sand**	**water**
cotton	**syrup**	**gold**	**tin**

2 Try to think of a solid or liquid beginning with each letter of the alphabet.

3 Look in magazines and newspapers and cut out as many pictures as you can of objects made of different solids and liquids. Make your pictures into a display. Label your pictures to say what solids and liquids are in the objects and what they can be used for.

4 Use a library to find out the answers to the following questions.

a What is the melting temperature of the metal called iron?

b Why does molten lava freeze as it moves further from a volcano?

c Penguins can live in very cold places. Why doesn't their blood freeze?

d Why is salt spread on icy roads in winter?

5 Make a collection of rocks and soils for your classroom. Label each one with an interesting fact about it.

6 What happens when you add some powders to water?

Make a collection of powders. You could start with baking powder, talcum powder, coffee and washing powder. Write down the name of each powder you have chosen. Add a little of each one to water. Explain what happened when you did this.

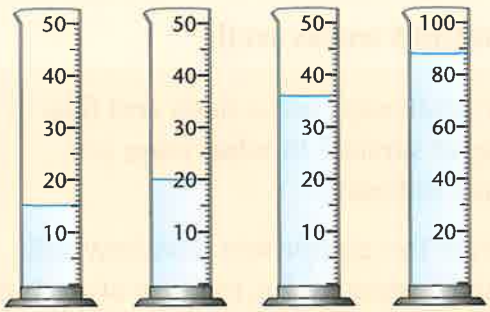
Can you get back any of your powders from the water?

Think of a good way of getting back the powder from water. Clue: you might use a filter or boil off the water.

Now try your ideas and record your results.

7 Search the Internet to find as many different rocks as you can. Where could your rocks be used?

8 What is the volume of water in the following measuring cylinders? Look carefully, the scales might be different.



All about forces

Before you start you should know that:

- forces cause pushes, pulls and turns
- some everyday forces are large and some are small
- magnets produce a magnetic force
- gravity is a force that pulls objects towards the centre of the Earth

At the start of the unit you will learn about magnets and springs and that:

- forces also produce turns and twists
- forces act in a particular direction
- materials are either magnetic or non-magnetic
- magnets attract some materials but not others
- magnets come in different shapes and strengths
- two magnets can either attract or repel each other
- springs can produce a force

Later in the unit you will learn more about the force of friction and:

- what causes the force of friction
- where friction occurs in everyday life
- where friction can be a helpful force or be a nuisance
- about air and water resistance
- how you measure a force using a newton meter
- that the correct units of forces are newtons (N)

What can forces do?

Pushes, pulls, turns and twists are all examples of forces. When one or more of these act on an object they can make it move, stop it moving, change its shape or its speed. If you look carefully all around you now, you will see forces in action.

What happens when you push or pull an object?

Some objects are **stationary** – they are not moving. If you give a push or a pull to a stationary object you might make it:

- start to move;
- change its shape.

If you push or pull a moving object you might make it:

- stop moving or slow down;
- move quicker;
- change direction;
- change its shape even more.

What is the difference between a turn and a twist?

Forces can also be used to **turn** or **twist** an object.

One push or pull can make an object turn around. It stays in the same spot but each part now faces in a new direction. This happens when you balance a ruler on a table.

When an object is twisted, its top end turns one way and its bottom end turns the other way. Two turns, in opposite directions, are needed to make an object twist.

Where can you see the effects of forces?

You cannot actually see a **force**, but you can see what it can do. Forces change the speed, direction or shape of objects.

Look at the children playing in the school playground. Look for the pushes and pulls, twists and turns. Which objects are starting to move, speeding up, slowing down, changing direction, twisting, turning or becoming a different shape?

1 Write down seven sentences which explain all the things which might happen when a force acts on an object. An example is 'When my dad pushed his car, it started to move.'

2 Explain the difference between a turn and a twist. You can draw pictures to help you explain this.

3 Look at the playground picture again. Write down a list of all of the things forces are causing to happen. Sort them into a table which shows the pushes, pulls, turns and twists. One has been done for you.

Pushes	Pulls	Turns	Twists
		turning skipping rope	

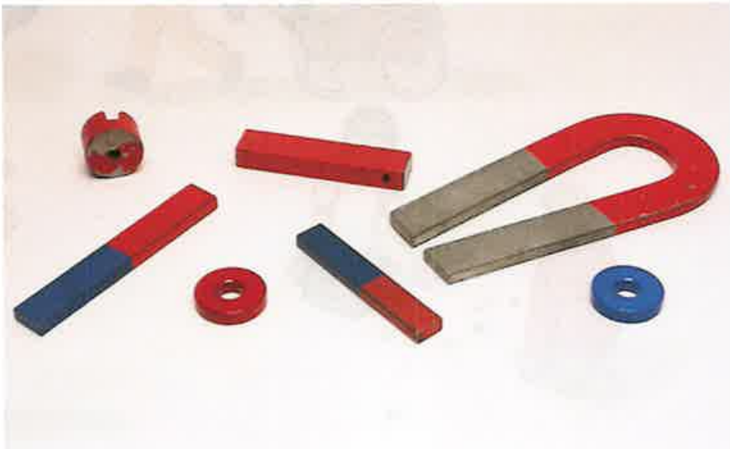
Magnets and their uses

Magnets are usually made from the metal called iron. The ends of a magnet are called poles. All magnets have a North and a South pole. You can detect forces when two magnets are brought close together. Sometimes they pull each other closer and sometimes they push each other away.

What do magnets look like?

Magnets come in different shapes and sizes. They are usually made of iron. The two ends of the magnet are called magnetic **poles**. There is a north pole and a South pole.

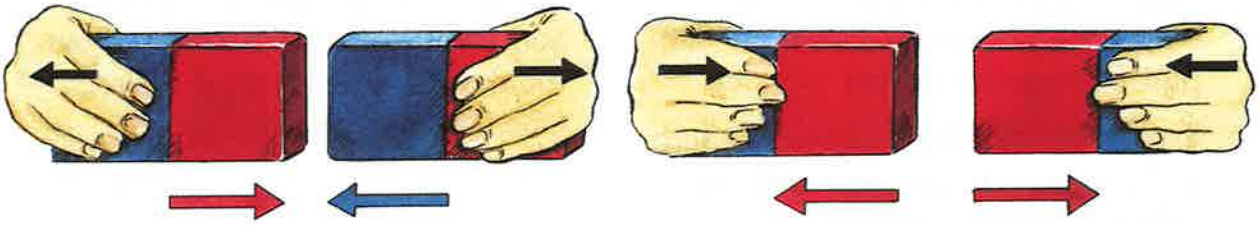
Forces can be felt between two magnets. The forces are strongest at the poles. Different magnets produce different sized forces.



What happens when you bring two magnets together?

Bringing two different poles together.
When the North pole of one magnet is brought close to the South pole of the other magnet they attract each other.

Bringing two similar poles together.
When the two North poles or the two South poles of two magnets are brought close together, they repel each other.



Remember the magnetic rule.

LIKE POLES REPEL and UNLIKE POLES ATTRACT each other.

How are magnets used in everyday life?

Magnets can be used in many different ways.

▲ Sara goes walking a lot. She uses a compass to help her find the way. It contains a small magnet, which always points towards the North pole of the Earth.

▲ Tom's dad has changed the oil in his car. This magnetic drain plug attracts bits of steel which have worn off the inside of the engine. This stops them damaging the engine.

▲ Sanjay's mother collects magnets to put on her fridge. They are very attractive. Sometimes she uses them to fix a shopping list to the fridge.

▲ Katy's fridge has a magnetic strip round the edge of the door. This helps the door stay closed.

1 Write a few sentences which explain in your own words what is meant by the words magnet, poles and the magnetic rule. Use some drawings if they will make your answer clearer.

2 Use a CD ROM and the books in your school library to find out about how magnets are used in everyday life. Make an exciting poster, which shows the rest of your class what you have found out.

Magnetic materials

Very few materials are attracted to a magnet. They are the metals iron, cobalt and nickel. Materials which are attracted are called magnetic materials. All other metals and other materials such as paper and rubber are non-magnetic and cannot be attracted.

What are magnetic materials?

Magnetic materials are those that are **attracted** by magnets. They are never pushed away (**repelled**) by a magnet. Magnets have no effect on **non-magnetic** materials.

Magnets only attract objects that are made out of three kinds of metal. The metals iron, cobalt and nickel are the only ones that are magnetic and attracted by a magnet.

Which materials are magnetic?

Nearly all the materials you know are **NOT** attracted to a magnet. Non-magnetic materials include paper, wood, plastic, rubber and aluminium.

Many people think that all metals are attracted to a magnet. But they are wrong. Metals like copper or tin are not attracted.

▲ Only some materials are magnetic and attracted by a magnet.

Testing to find the magnetic material

Class 4T are testing lots of different materials to find out which materials are magnetic and which ones are not.

- They thought the best way to spot the magnetic materials was to test each one with a magnet.
- If the material was attracted by the magnet it would be magnetic.
- If they couldn't detect any attraction it would be a non-magnetic material
- Each person made a prediction about which materials would be magnetic or non-magnetic materials.

Here is what we predicted

	Paper clip	Rubber	Ring	Can	Ruler	Coin	Nail	Paper
Tom	✓	✗	✗	✗	✗	✗	✓	✗
Clare	✗	✗	✓	✓	✗	✓	✗	✓
Matthew	✓	✓	✗	✗	✓	✓	✗	✗
Yasmin	✓	✗	✗	✗	✗	✗	✓	✗
Jack	✗	✓	✗	✗	✓	✗	✗	✓
Mina	✓	✗	✗	✓	✓	✓	✓	✗

Here is what we recorded in our books

	Paper clip	Rubber	Ring	Can	Ruler	Coin	Nail	Paper
Tom	✓	✗	✗	✓	✗	✗	✓	✗
Clare	✓	✗	✗	✓	✗	✗	✓	✗
Matthew	✓	✓	✗	✗	✓	✗	✓	✗
Yasmin	✓	✗	✗	✓	✗	✗	✓	✗
Jack	✓	✗	✗	✓	✗	✗	✓	✗
Mina	✓	✗	✗	✓	✗	✗	✓	✗

Think about how the final results compared with their predictions. What do you think each person was thinking?

1 Name the only three metals that are magnetic materials.

2 Explain how you would tell the difference between a magnet and a magnetic material.

3 Which material do you think the paper clip, can and nail are made out of?

4 Look at Class 4T's results. Who:
- got all their predictions correct?
- got all their predictions wrong?
- thought that all metals were magnetic materials?
- thought metals were non-magnetic?
- is the worst at testing?

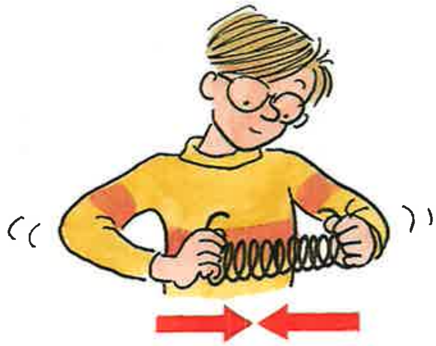
Springs and elastic bands

Forces can be used to change the shape of a spring by stretching or squashing. When a force acts on a spring, the spring exerts an equal force in the opposite direction. Elastic bands can be used to compare the pull of gravity on different objects.

What happens when you pull or push on a spring?

Jack used forces to change the shape of a spring.

▲ *Jack pulled the spring to stretch it.*



▲ *Jack pushed the spring to squash it.*

When Jack pushed the spring, he felt the spring pushing back against his hands. As he **stretched** the spring, he could feel it pulling back. When Jack let go, the spring returned to its original shape.

What happens when you use a stronger spring?

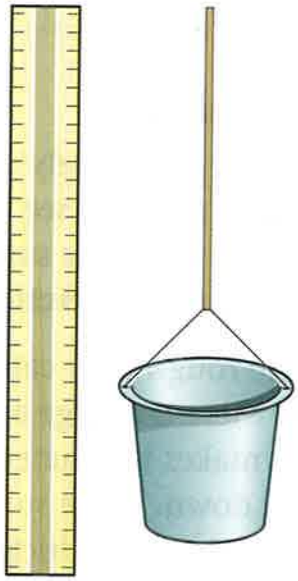
A stronger spring is harder to stretch or **squash**. Jack had to use a greater force to change the shape of this spring. He could feel the force exerted by the spring as it tried to return to its original shape.

How can gravity affect the stretch of an elastic band?

If you hang an object on the end of an elastic band, gravity pulls down on the object and stretches the elastic band. A heavy object will stretch the elastic band more than a light object.

Sara used an elastic band to compare the pull of gravity on different things.

- First, she attached an empty pot to an elastic band and measured the length of the band with a rule.
- Then she filled the pot with different objects. She measured the length of the band again to see how much it had stretched.
- She recorded all her measurements in a table.



Here are Sara's results.
What did she find out?

Object pulled by gravity	Length of elastic band
empty pot	8 cm
pot of chalk	18 cm
pot of soil	30 cm
pot of stones	25 cm
pot of conkers	17 cm
pot of sand	34 cm

1 Which forces are acting when you stretch a spring? Draw a picture with arrows to show the forces and write down what is happening.

2 Write down a list of six everyday things that work with a spring.

3 Which of Sara's pots stretched the elastic band the most? Write down in your own words what Sara's results tell you about the force of gravity.

The force of friction

Friction is a force that is found whenever two objects slide over each other. The rubbing between the surfaces slows the objects down and eventually stops them moving. If the two surfaces are rough there will be a lot of friction between them. If they are smooth there will be less friction.

How is friction caused?

Solid materials are never completely smooth. Using a magnifying glass you can see tiny 'hills and valleys'. These catch when the surfaces rub against each other and cause the **friction**.

If the two surfaces are rough they catch against each other a lot and there is a large amount of friction. The friction makes the materials warm as well as slowing them down. If the surfaces are smooth there will be only a little friction.

Is friction useful?

Friction can be very useful. There is a lot of friction between the tyres on this car and the road. It helps to stop the car very quickly. If there were no friction between them there would be a nasty accident. High friction is useful here.

A playground slide is highly polished. There is only a small amount of friction between the slide and your body when you use it. So you can slide down it easily. Low friction is useful here.

Friction in everyday life

Friction occurs all around you. Friction can be useful. For example, the high friction between your shoes and the ground stops you slipping over. But friction can also be a nuisance. If you walked over smooth ice, the low friction might cause you to slip and hurt yourself.

Look for ten examples of friction in this picture. Discuss each example with your friend using words such as smooth, rough, high, low, useful and a nuisance.

1 Write a few sentences which explain how friction is caused. Use diagrams if these will help.

2 Draw a table like this one in your book. Use the pictures on this page to help you fill it in. Think about your walk to school today. Try to add another five examples of where you saw friction happening and add these to your table.

Where I saw friction	The surfaces which rubbed	High or low friction	Useful or not

Water and air resistance

Friction also happens as objects move through water or air. This is called water or air resistance. Some shapes move through air or water well. They are streamlined.

Water resistance

When an object moves through water there is friction. This slows it down. Objects that have a large and flat front end move badly through water. They have a big **water resistance**. Objects which have a thin, pointed front end have less water resistance.

These fish can move through water easily. The shape of their bodies is **streamlined**. They can easily push through water and have a low water resistance.

Proving that shape matters

Miss Taylor asked Sara to make some different shapes out of plasticine and to test them to see which ones produced the most water resistance. Here is part of what she wrote in her book.

This is the apparatus I selected.

My test is fair because I used the same mass of plasticine to make four different shapes.

I measured the time each one took to fall from the top to the bottom of the water. I made sure I measured this in seconds and that the distance dropped was the same each time.

I did each test a number of times so that I could work out an average of my results.

Shape of plasticine	Time to fall (seconds)	
	4.7	4.4
	4.3	4.6
	2.0	2.1
	1.9	2.0
	2.6	2.8
	2.4	2.6
	3.0	3.4
	3.1	3.5

Air resistance

Objects that fall or move through the air also feel a resistance. This is caused as the air rubs against the surface of the moving object. Streamlined objects that have a sharp and narrow front move much better through air than **non-streamlined** ones.

You can feel **air resistance** when you ride your bike. This is caused by air rubbing against you. The faster you go the bigger the **air resistance** gets.

How quickly do parachutes fall?

A parachute slows down as it falls through the air. It is not streamlined. It has a large canopy that makes a large air resistance as it falls. If the parachute had a small canopy it would produce much less air resistance and fall much more quickly.

1 Look carefully at Sara's results. Work out the average time it takes for each piece of plasticine to fall through water. Put the shapes in order starting with the quickest. What does this tell you about how different shapes move through water?

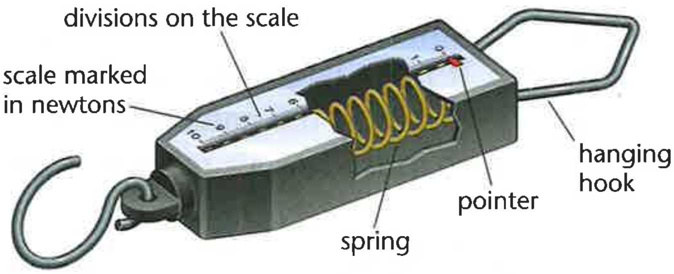
2 Design and draw two cars: one that will move through air quickly and one that will move slowly. Explain why you have designed the cars the way you have. Use the idea of air resistance to help make your answer more scientific.

Measuring forces

Forces are measured in units of **newtons** (N) using a newton meter. The newton meter has a calibrated scale. This lets you measure any force whose size is between the smallest and the largest marking on the scale. **Newton meters** can measure quite large forces but very large ones have to be calculated.

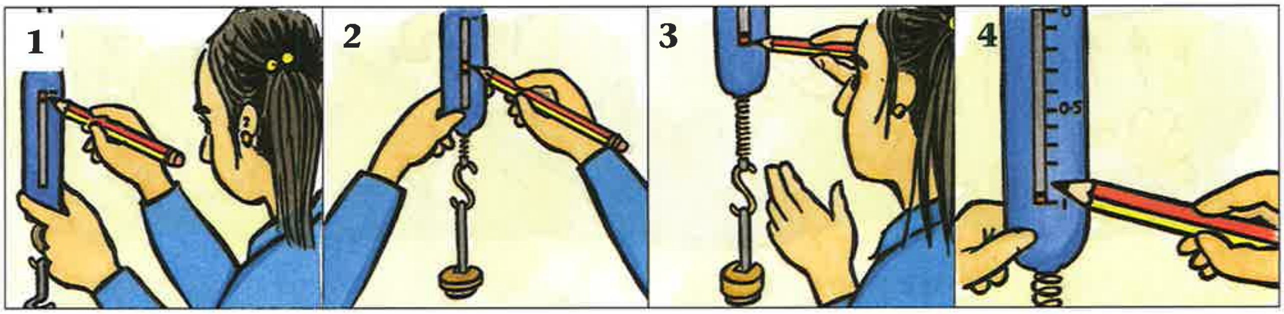
What is inside a newton meter?

Newton meters contain a stretchy spring. When an object is attached, a force makes the spring get longer. The bigger the pulling force the more the spring stretches. If you double the pulling force the spring will double its length.



How do you calibrate the scale?

Mina used the following way of calibrating a newton meter. The meter measures forces up to 1 N. Weights can be added one by one and the scale marked each time.



1 When there is no pull, the spring is unstretched. Mina marks the top of the scale.

2 A 0.5 N weight stretches the spring. Mina makes a second mark. She does this very accurately and notices that it is about halfway down the scale.

3 A 1 N weight stretches the spring twice as far. Mina marks this point on the scale.

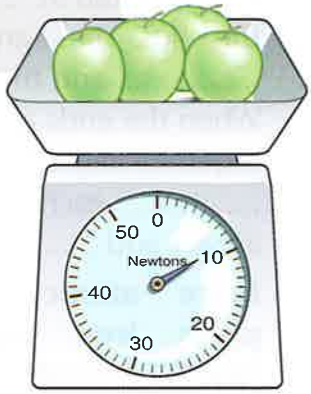
4 Mina makes more marks on the scale by dividing the total length into ten equal parts. Making more marks helps increase the scale's accuracy.

Measuring small and large forces

Newton meters are designed to measure forces of certain sizes. Some newton meters are used to measure small forces and others to measure larger forces.

Larger forces are measured by newton meters which have a stronger spring inside them. The scale shows you the size of the force it can measure.

Bathroom and kitchen scales are larger versions of the scientific newton meter. Although they look different they still use springs to measure the force.



Look closely at these pictures. **They measure the force in newtons, which is correct.**

The bathroom scales you use at home are probably marked in kilograms. These are measurements of mass. Mass is not a force.

▲ *Newton meters are used in everyday life too!*

1 What scientific instrument is used to measure forces?

2 Explain why a newton meter which can measure up to 10 N has a stronger spring inside it than one which measures up to 1 N.

3 Draw four pictures of a newton meter measuring forces of 0.75 N, 0.8 N, 0.25 N and 0.2 N.

Test your knowledge

1 Use the words from the list below to fill in the spaces. Write out the complete paragraph neatly in your book with the correct words added and underlined. Then design an exciting poster which will tell your friends about the science of a magnet.

Only a few .... are magnetic. Magnets are usually made from .... , cobalt or nickel. The .... of a magnet is more concentrated at .... points near the ends. These are called the .... and the south .... When the ends are brought close together they either .... or .... each other. .... poles attract and .... poles repel.

force attract two unlike
poles iron repel like
north metals

2 Make a concept map about forces using the following ideas.

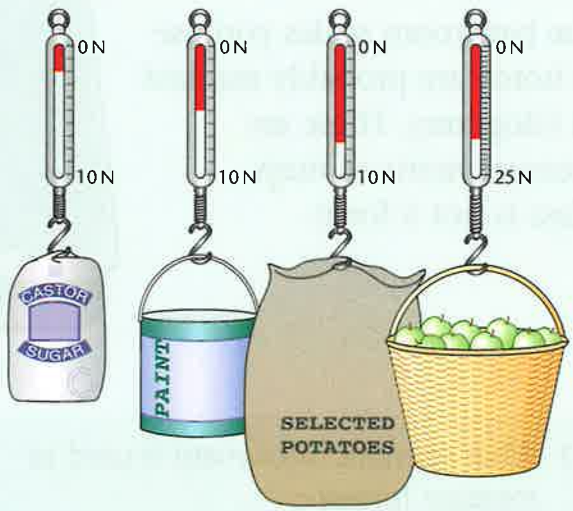
force	**push away**
pull towards	**attract**
repel	**magnet**
compress	**spring**
elastic	**stretch**
size of force	**pole**

Add some more words if these will help. How big can you make it?

3 Can you explain this magic trick? Write down in your own words what is happening and draw pictures to help you.

The magician marks a letter with a paper clip then spins the wheel and points his wand. The wheel stops when the marked letter is opposite the wand.

4 Write down the readings on the following newton meters.



Light and shadows

Before you start you should know that:

- light comes from a variety of sources
- the main source of light in the daytime is the Sun
- darkness happens when there is no light
- you need light to help you see

In this unit you will learn more about light and that:

- light travels in a straight line from its source
- shadows are made when light from a source is blocked
- shadows are similar in shape to the objects that make them
- the Sun rises in the morning in the east and sets in the evening in the west
- the Sun can form shadows during the day
- the length of shadows change during the day as the Sun moves across the sky
- long shadows are formed in the early morning and late afternoon when the Sun is low in the sky
- shadows formed by the Sun are shortest when the Sun is high in the sky
- you can tell the time using shadows and a sundial
- light can shine through some materials but not through others

Learning about light

Light travels in straight lines from its source. It cannot bend to travel around corners. Shiny surfaces, like a mirror, reflect light and make it travel in a different direction. You see things when light shines on them and is bounced off into your eyes.

How does light travel?

Light travels in straight lines from its **source**. It cannot bend round corners.

The children in Red class looked through straight tubes at a lighted candle. Everyone could see the candle. The light travels in straight lines in all directions from the candle.

The children tried looking through bendy tubes. No-one could see the candle. The light from the candle cannot travel around the bends in the tube.

How can light be made to travel round a corner?

Mina shone a torch at Jack. Jack **reflected** the light with a mirror so it shone back at Mina.

Jack turned the mirror to reflect the light on to the wall. The mirror makes the light travel in a different direction.

How do we see things?

You see objects when light shines on them. Light is bounced off an object and, when you look at it, the light enters your eyes.

If you look at an object in the dark you cannot see it because there is no light to bounce off it into your eyes.

Mina is reading a book. When the lamp is on she can see the page clearly.

Mina can only see the book when light is shining on it. The light is reflected (bounced off) the book into her eyes.

There is a power cut and the lamp goes out. Now Mina cannot see the book.

1 Copy the sentence and fill in the gaps.
Light travels in a .... from its .... Mirrors can .... light.

2 Real darkness is where there is no light at all. Write down in your own words why we cannot see in the dark.

3 Draw yourself looking at a clock. Put in arrows to show how you see the clock. (Clue – Don't forget the source of light!)

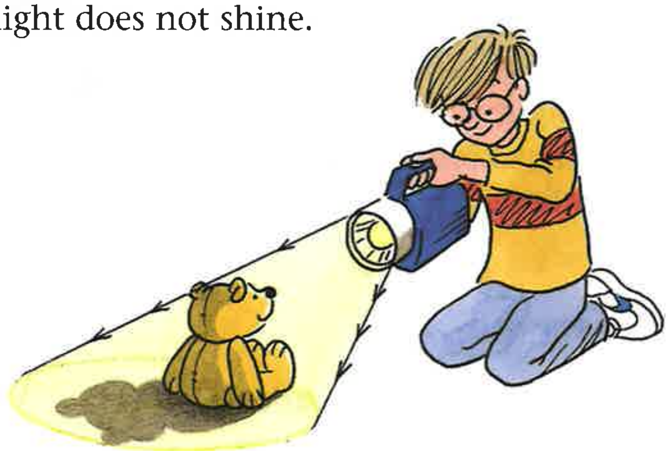
Shadows

Shadows are made when light shines around an object but cannot shine through it. The shadow is made on the opposite side of the object from the light source. Shadows can be big or small. It depends on how far away the light source is from the object.

What makes a shadow?

A **shadow** is made when light shines on an object but cannot pass through the object. The object blocks the light so there is a dark shape behind the object where the light does not shine. This dark shape is the shadow.

When Jack shone a bright lamp on his teddy bear, a shadow appeared behind the bear.



The light from the lamp passes around the outside of the bear and makes a pool of light on the floor. The light cannot pass through the bear so the floor behind the bear stays dark.

Jack switched off the lamp and the teddy bear's shadow disappeared.

Where did the shadow go?

When light shines on an object from above, the object does not cast a shadow.

Jack noticed that the bear had no shadow. He lifted up the bear and saw the bear's shadow on the floor.

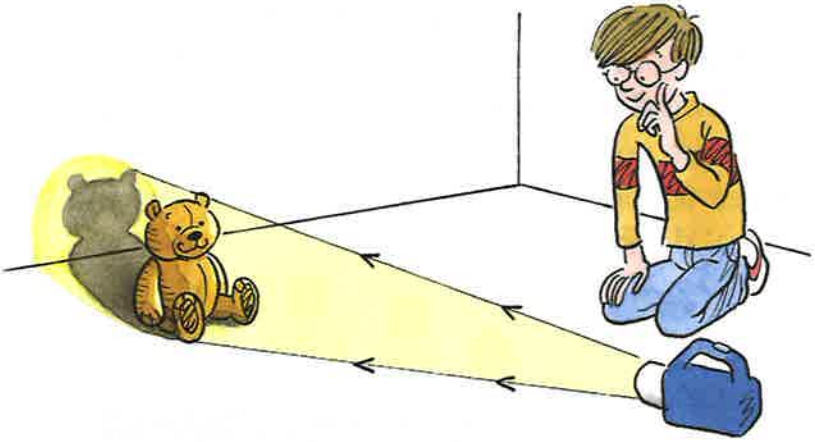
The ceiling light shines down on the bear and round the outside of it. The light still cannot shine through the bear so the shadow appears on the floor beneath the bear.

Why do shadows change in size?

Shadows get smaller as the distance between the object and the light source gets larger.

Jack sat the teddy bear near to a white wall and shone a bright lamp on the bear. The bear's shadow appeared on the wall behind it.

Jack moved his lamp further away from the bear. The bear's shadow got smaller.



When Jack moved his lamp close to the bear, the bear's shadow became very big.

1. Draw a picture and write down in your own words how shadows are formed.
2. Copy this sentence into your book and fill in the gaps.

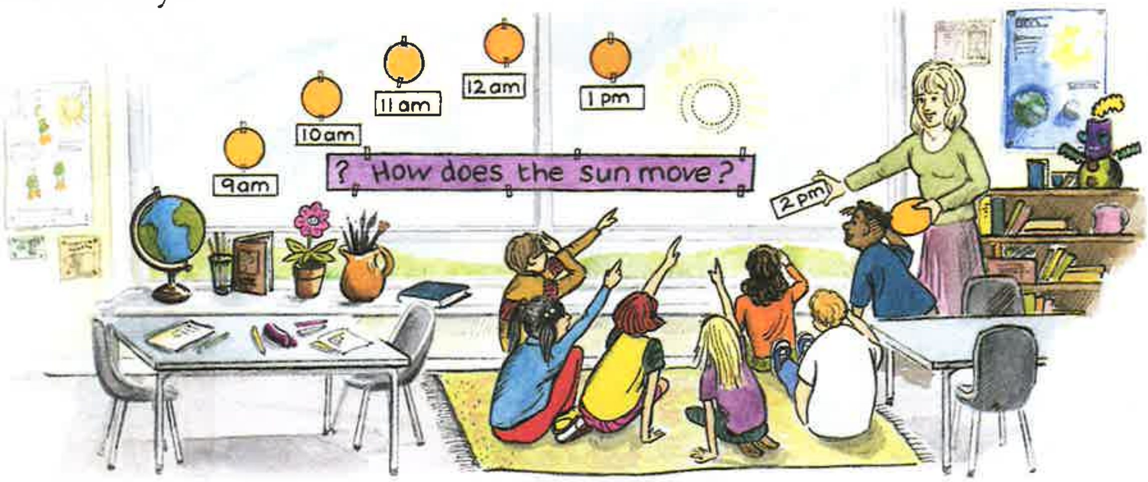
When an object is close to a .... of light its shadow will be .... When an object is further away from a .... of light its shadow will be ....

Movements of the Sun

The Sun appears to move across the sky in the same pattern each day. It starts below the horizon, rises until it is the middle of the day and finishes low again in the evening. The Sun doesn't really move. It is the Earth spinning that makes the Sun look as if it is moving.

How does the Sun appear during the day?

Miss Taylor has asked her class to think of a way to show where the Sun is at different times of the day. The class decided that they would put a sticker on the classroom window every hour to show the position of the Sun in the sky. They were very careful **never** to look directly at the Sun. They did the same thing for several days.



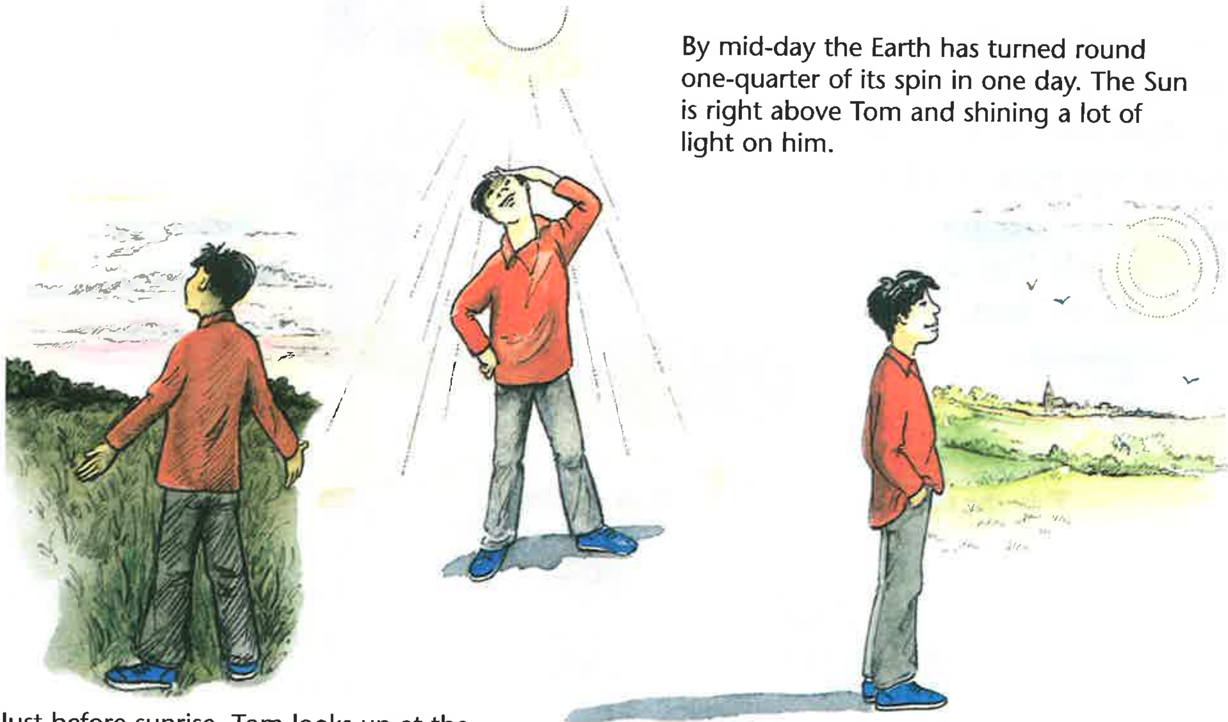
They discussed the pattern they saw on the window. This is what they decided.

- The Sun moves across the sky in the same pattern every day.
- It always moves in the same direction: from the East to the West.
- It does not move across the sky in one direction one day, and back in the other direction the next day.
- It gradually gets higher until the middle of the day. It then gets lower during the afternoon.

What is the Sun really doing?

The Sun looks as if it moves during the day and the Earth stays still. For many years people believed that this is what happened. They thought that the Earth stayed still at the centre of the universe. It looked as if all the other stars and planets moved around it.

But there is another way of making sense of what you see. The Sun stays still and the Earth moves. The Earth spins around on its axis once every day. This is how Miss Taylor explained what the class saw.



By mid-day the Earth has turned round one-quarter of its spin in one day. The Sun is right above Tom and shining a lot of light on him.

Just before sunrise, Tom looks up at the sky. He cannot see the Sun. It is dark. The Earth is spinning anti-clockwise and the Sun slowly rises above the horizon.

Later in the afternoon the Earth has turned round more. It is still daylight as Tom can still see the Sun but it is starting to get dark.

1. From which direction does the Sun rise? In which direction does it set?
2. The Sun appears to be moving across the sky. Explain in your own words why this is not really happening. Act out what really happens with your friends.
3. How long does it take for the Earth to spin around one complete time?
4. Two famous scientists called Nicolas Copernicus and Galileo first said that the Earth moved around the Sun. Find out more about them using the Internet.

Shadows through the day

As the Sun crosses the sky, the shadows move round. Shadows are longer in the mornings and evenings than at midday. They are at their shortest at midday. Shadows form when the light from the Sun is shaded by an object.

What makes a shadow?

If you stand outside on a sunny day you will see your **shadow**. When you move so will your shadow. Your shadow will always be on the side that faces away from the Sun.

In the morning.

At midday.

Matthew went into the playground in the morning and then again at midday. He found the length of his shadow had changed. In the morning it was longer than at midday.

In the morning and in the afternoon the Sun is lower in the sky than at midday. The higher the Sun in the sky, the shorter the shadow. By the evening Matthew found that his shadow had become very long.

What happens to shadows throughout the day?

Matthew and Yasmin decided they would find out more about shadows. Matthew drew round Yasmin's shadow at different times during a sunny day.

They found that as the Sun appeared to move from east to west, the position of the shadow changed. The shadow became shorter as the Sun rose higher in the sky. As the Sun sank lower in the sky, Yasmin's shadow became longer.

Matthew and Yasmin cast shadows because they are both **opaque**. Light cannot pass through them. A shadow is formed when their bodies prevent light from reaching the ground.

▲ *You can use shadows on a sun-dial to tell the time.*

1 What differences are there between a shadow at midday and a shadow in the morning?

2 Explain what causes a shadow to form. Write your answer using diagrams and complete sentences. Use good scientific words.

3 Yasmin is sitting on a beach under a sunshade. During the day she has to keep moving to stay in the shade. Draw pictures of the sunshade and its shadows to show how they will change during the day.

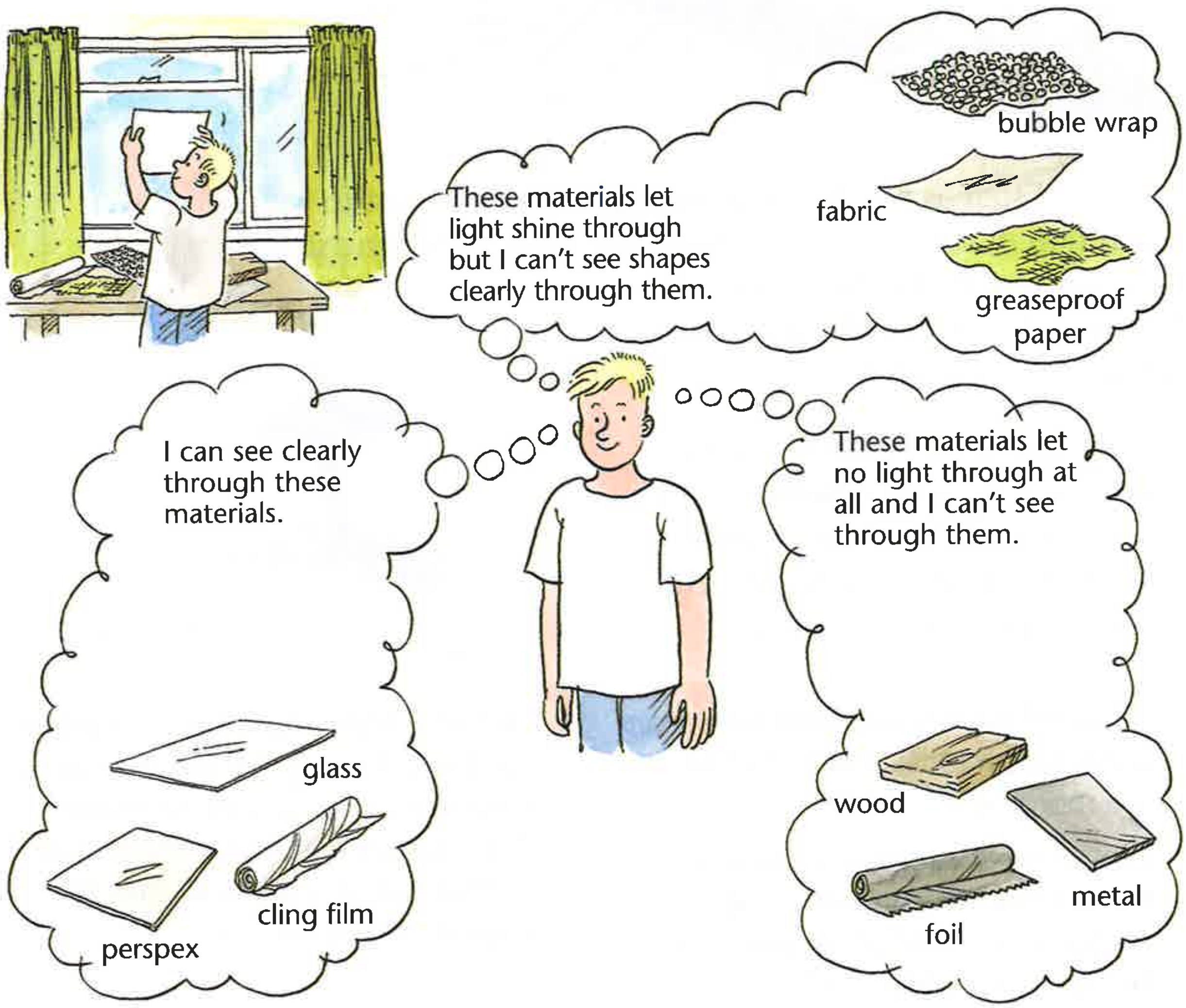
Transparent, translucent and opaque

Light can shine through some materials but not others. Opaque materials will not let any light through. You can see through transparent materials, because they let all light through. Translucent materials let some light through but are not see-through.

Can you see through it?

Matthew held sheets of different materials up to the window. This is what he found out.

▼ ***Translucent** materials*



▲ ***Transparent** materials*

▲ ***Opaque** materials*

What materials make the best shadow puppets?

Matthew decided to make some shadow puppets from his materials. He cut out some shapes and made a screen from white paper. Light from a torch made the shadows.

He found out that the opaque materials made the best shadow puppets because none of the light could get through. He cut holes in some of the shapes to let the light through so that his shadow puppets could have eyes, a nose and a mouth.

1 Look around your classroom. Draw and label three things made from transparent material, three things made from opaque material and three things made from translucent material.

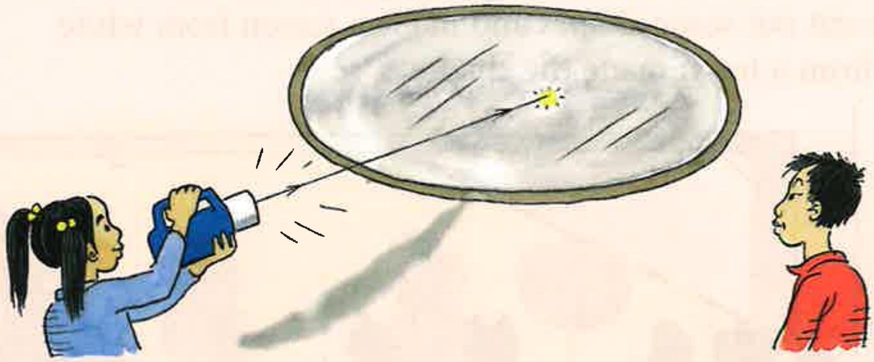
2 Match the two halves of these sentences correctly. Write the correct ones into your book.

- Transparent materials let — some light through.
- Opaque materials let — all light through.
- Translucent materials let — no light through.

3 Which materials would you choose to make a shadow puppet and why? Write your sentence like this, filling in the gaps.

I would choose .... and .... because ....

Test your knowledge



1 When Mina shines the torch at the mirror the light shines in Tom's eyes. Copy the picture into your book and draw another arrow to show what happens to the light after it hits the mirror. Write an explanation under the picture.

2 Copy the sentences and fill in the gaps using the words in bold below and some of your own words to complete each sentence.

I would use transparent glass for my .... because ....

I would use translucent glass for my .... because ....

I would use metal for my .... because it is .... and ....

garage door **kitchen window**

bathroom window **opaque**

3 Draw yourself and your shadow. Draw a source of light in the right place to make your shadow.

4 Choose the correct words from the list to complete each sentence. Write out the sentences in your book.

a The Sun rises in the .... and sets in the ....

north **south** **east** **west**

b When our part of the Earth faces away from the Sun it will be ....

daytime **night-time**

c A shadow is shortest at ....

morning **midday** **evening**

5 All of these sentences are **false**.

- The Sun moves around the Earth.
- It is safe to look at the Sun.
- In the morning the Sun is higher in the sky than at mid-day
- Cling film is an opaque material.
- You can tell the time accurately with a sundial.
- The Earth spins in a clockwise direction.

Re-write each sentence to make it true. Explain what was wrong about the original sentence.

Electrical circuits and conductors

Before you start you should know:
- many everyday appliances use electricity
- there are some appliances at home and in school that use electricity from the mains or from batteries

At the start of this unit you will learn about using electrical circuits and:
- what components are needed in a circuit
- how a bulb works
- that there are different batteries and switches and how you use them in a circuit
- the need for a complete circuit

Later in the unit you will learn more about circuits and conductors and insulators and:
- which materials are electrical conductors and insulators
- how to add buzzers and motors into a circuit
- how to change the speed and direction of a motor
- where mains electricity comes from
- what dangers there are in your home

Making a circuit

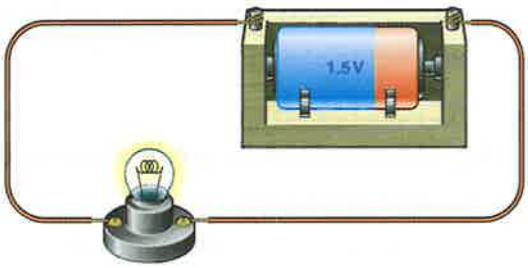
A bulb lights when it is connected by wires to a battery in the right way. When the bulb is connected like this, we call it a circuit. The light from the bulb comes from a thin wire inside it. This wire gets hot and glows when electricity passes through it.

What makes the bulb light?

To light a **bulb** you need the bulb, a **battery** and some wires. They must be connected the right way to make a complete **circuit**.

If you connect the wires to opposite ends of the battery the bulb will still light.

▼ *The circuit is complete – the bulb lights.*



What are the wires like?

The wires in the circuit are called either **leads** or electrical cable. Wires are made of metal.

▼ *This is a piece of electrical cable.*

Metals conduct electricity. They let electricity pass through. To make the wire safe to touch it is usually covered in plastic.

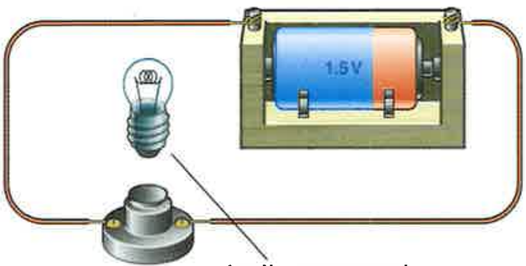
To make the bulb light *the metal wire* must touch the battery and the lamp connectors.

What happens if you remove the bulb?

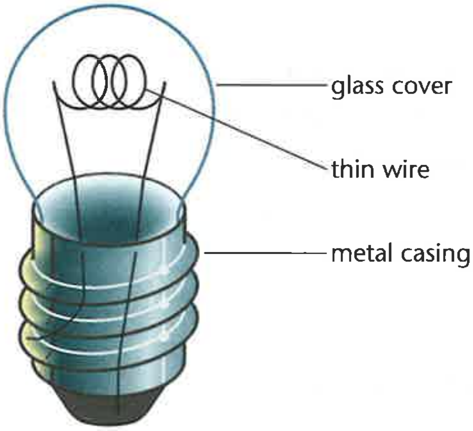
Unscrew the bulb from its holder. The lamp will go out because no electricity is passing through the bulb.

Remove one of the leads from the battery. The same thing will happen – the bulb does not light.

▼ *The circuit is not complete – the bulb doesn't light.*



What is inside the bulb?

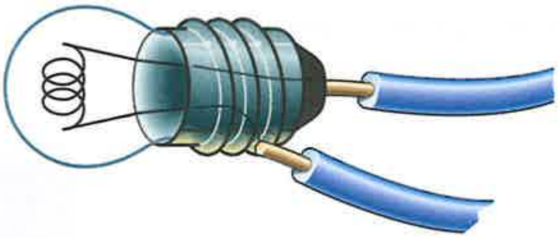


▲ *The wire gets hot and glows.*

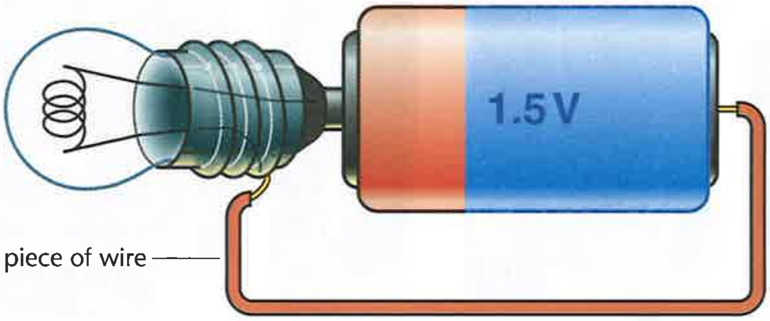
Look closely at the bulb. You will see a thin wire inside the glass cover. The electricity must pass through this wire for it to get hot and give out light.

When the bulb is put in a circuit, one lead must touch the bottom of the bulb and the other lead must touch the metal casing.

Look carefully at this drawing. It shows you how to connect a bulb into a circuit without using a bulb holder.



You can use leads made from *any wire*. As long as they are connected the right way to the battery, the bulb will light.



1 What part of the bulb lights up?

2 Make drawings of what you need to make a bulb light up.

3 Write down three good reasons why a bulb might not work when you fit it into a circuit.

4 Why is an electrical cable made of both metal and plastic?

Batteries

Batteries or cells provide the voltage to push electricity round a circuit. Batteries have positive (+) and negative (–) terminals. When a number of cells are used they must be connected positive to negative. The higher the voltage used, the brighter the bulb.

What do batteries do?

There are many different types of battery. Torches and some toys use the larger batteries. Watches and calculators use much smaller batteries. The V on the battery stands for **volts**. The **voltage** of the battery is the 'push' needed to make the electricity flow in the circuit.

▼ *Here are examples of different batteries.*

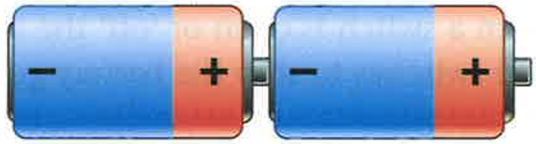
The higher the voltage of a battery, the brighter the bulb will light when it is connected to the battery. A battery uses chemicals to make electricity. When these chemicals are used up, the battery stops working or goes 'flat'.

If you look carefully at a battery you will see that there is a plus sign (+) at one end and a minus sign (–) at the other. These ends are called the **terminals**. We write them as positive (+) and negative (–).

How do you connect a battery into a circuit?

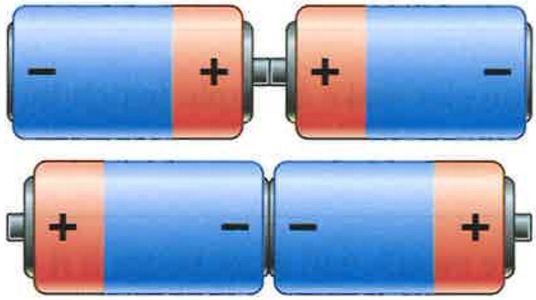
Each 1.5 V battery is really called a **cell**. When you connect two or more cells together they are called **batteries**.

You must always connect the positive (+) terminal of one cell to the negative (–) terminal of another cell.



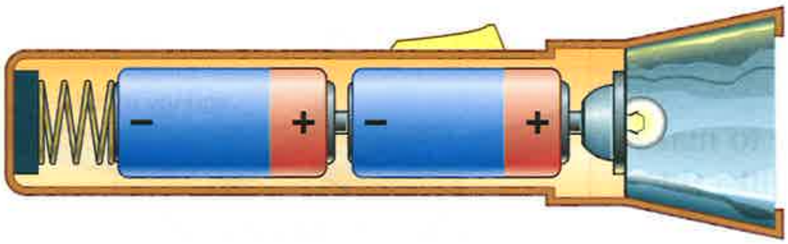
▲ *Connected like this cells will be able to work in a circuit.*

If you connect cells with two positive terminals touching, the circuit will not work. In the same way, a battery will not work if you connect two negative terminals together.



▲ *Neither of these will work in a circuit.*

A torch usually has more than one cell. The cells or batteries have to be connected in the same way – positive to negative – to light the bulb.



▲ *If you put the batteries in with both positive or both negative terminals touching, the torch bulb will not light.*

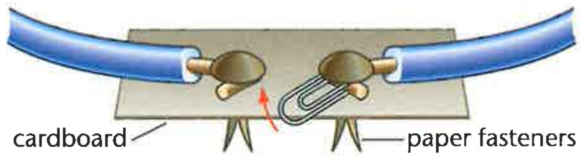
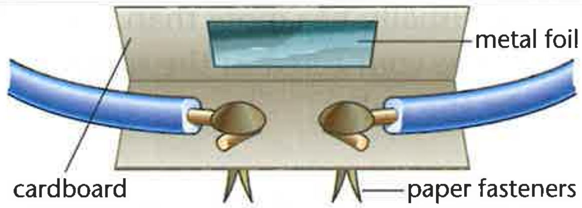
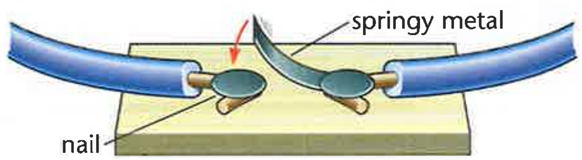
1. What is a cell?
2. What does a battery or cell do?
3. What happens to a battery if you use it in a circuit for a long time?
4. Make a drawing of the correct way to connect two cells.
5. Write down a list of everyday objects which use batteries.

Switches

Switches are used to turn circuits or electrical appliances on or off. When a switch is closed or 'on' the circuit is complete. When a switch is open or 'off' the circuit is broken. All circuits need switches to stop the battery going flat.

How can you make a simple switch?

Using a **switch** allows you to break a circuit.

You can make a simple switch by using a paper clip.	
The switch will work better if it can be connected to the ends of the leads more easily.	
You can make a switch from metal foil, cardboard and two paper fasteners like this. You hold the cardboard closed to turn the switch on.	
Another switch which is easy to make uses a piece of springy metal like this.	

▼ *These are switches that you may find in your home.*

Can we find other ways of using switches?

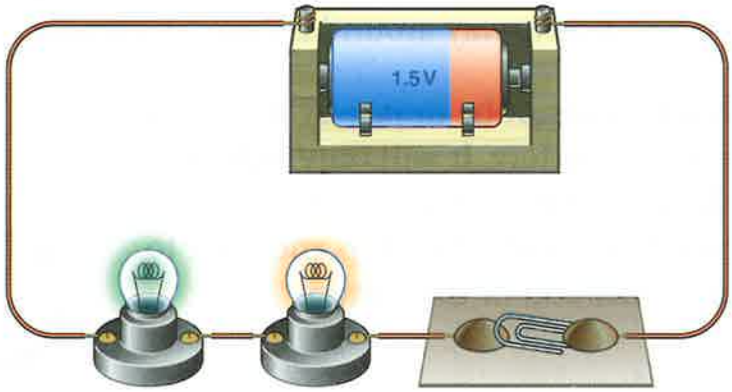
Some burglar alarms work by sounding an alarm when a switch is pressed down and closed. They can be placed under a mat by the door so the alarm sounds as the burglar steps on to the mat.

Can we switch lights on and off separately?

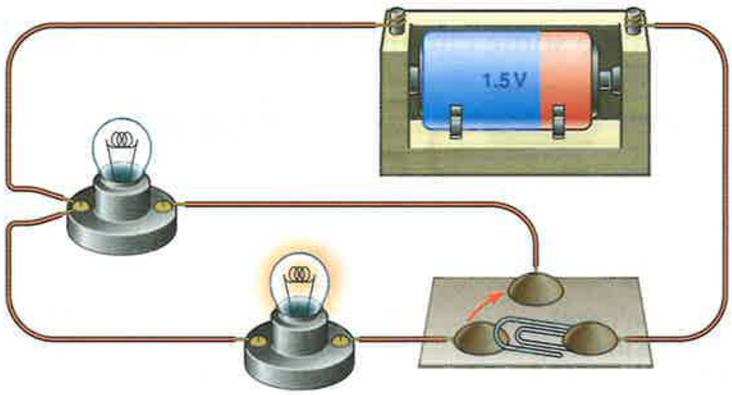
Sara wanted 'stop' and 'go' lights for her train set. She needed to have a switch which would change the lights from green to red.

At first she tried using one switch. This made the lights come on and go off together.

She added a second switch between the red light and green light. Both lights still came on and went off together.



Sara then tried a new circuit. She had to move the paper clip from touching one lead to touching another. This time it worked. When the red light was on, the green light was off. When the green light was on, the red light was off.



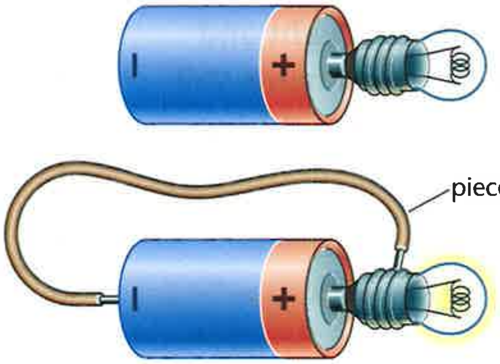
1. Why do you need a switch in a circuit?
2. Write down how you could make a simple type of switch or draw it.
3. Write down how a switch could be used to work a burglar alarm.
4. Invent your own type of switch. Draw a picture to show how your switch will work.

The need for a complete circuit

An electrical current only flows if there is a complete circuit. If there is a break in the circuit, the current will not flow. This is how a switch works. The need for a complete circuit can be shown when making quiz boards.

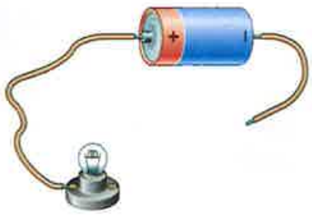
For an electrical current to flow it needs a source of electrical energy. This can be either a battery of cells or a power supply. The current also needs a **complete** way around from the source and back again. This complete way around is called a **circuit**.

A lamp cannot be lit just by touching it to the battery. It will only light if there is a path from one end of the battery through the lamp and back to the other end of the battery.

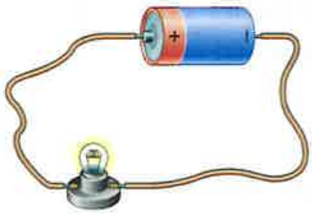


Jack made some circuits using a lamp, a battery and some connecting wire.

This didn't work because the lamp isn't connected at both ends.



This didn't work because there is a gap in the circuit.



This worked because there is a complete way around through the components.

This didn't work because the cell isn't joined at both ends.

A circuit will only work if there is a complete circuit.

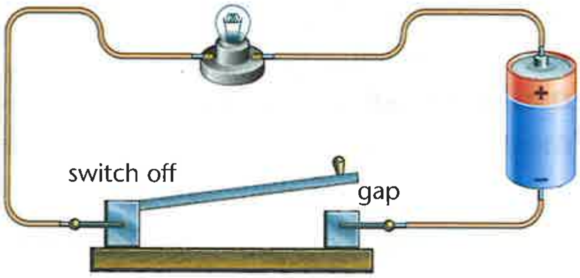
You only have a complete circuit when:

- there is a complete way around with no gaps;
- any battery is connected at both ends.

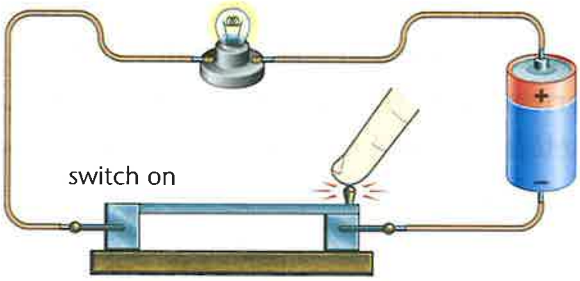
How do switches work?

A switch is really a break in a circuit.
It works by opening and closing a gap in the circuit.

To turn the current off you make a gap in the circuit and the current stops flowing.



To turn on the current you close the gap in the circuit and the current can flow.



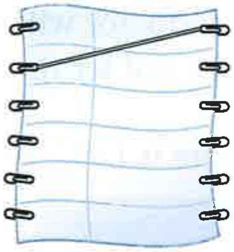
How does a quiz board use a complete circuit?

Mina has made up some questions and answers for a quiz. She put the questions and answers so that each answer is not next to its question.

She arranges the circuit so that it is complete only when a question is matched with its correct answer. The lamp will then light to say 'Well done!'

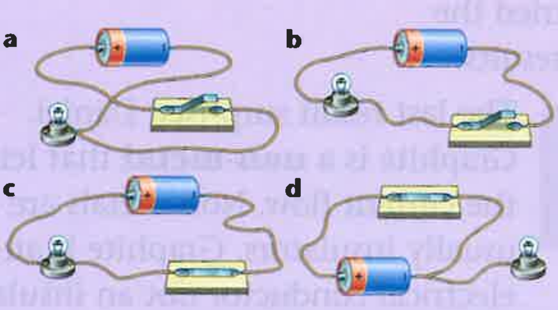
Here is Mina's quiz board.

Back of the board.

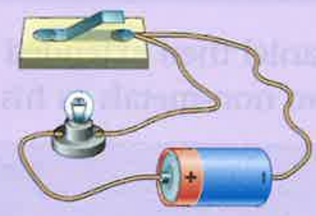


Only one question has been joined to its answer.
She will need to join the others with some connecting wire.

1 Which of these lamps would be on?



2 Redraw this circuit so that the switch can control the lamp.

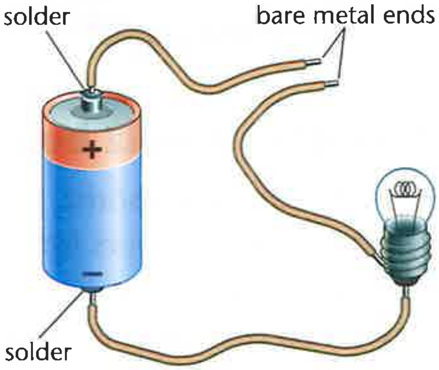


3 Draw Mina's quiz board to show the rest of the connections she needs to make.

Insulators and conductors

Some materials are conductors of electricity. Other materials are insulators. In a circuit we can use these properties to choose whether the electricity can flow or not. Switches use both conductors and insulators in their action.

If a material lets an electric current flow through it, you call it an electrical **conductor**. A material that does not let an electric current flow through it is called an electrical **insulator**. All metals conduct electricity. Plastic, rubber and most other non-metals are insulators.



Which materials are conductors?

Daniel used the gap between the bare ends to test each material. Any material that is an electrical conductor will let the lamp light up. Insulators will not let the lamp light.

Here is Daniel's table of results:

Object	Made of	Lamp on/off
compasses	metal	on
coin	metal	on
pencil sharpener	plastic	off
rubber	rubber	off
ruler	wood	off

The metals were conductors.
The non-metals were insulators.

Daniel then extended his experiment and tried the two non-metals in his pencil. Here are his results.

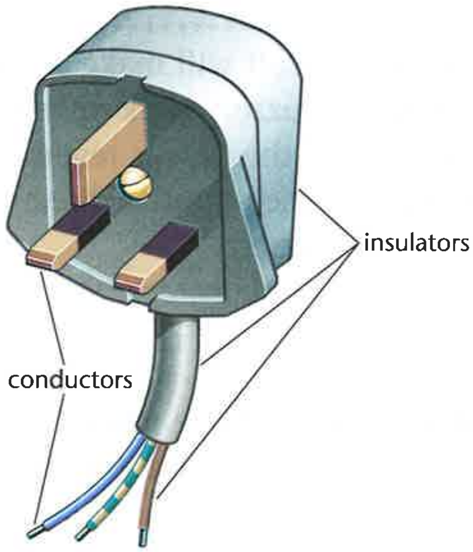
Object	Made of	Lamp on/off
pencil body	wood	off
pencil 'lead'	graphite	on

The last result surprised Daniel. Graphite is a **non-metal** that lets the current flow. Non-metals are usually insulators. Graphite is an electrical conductor not an insulator.

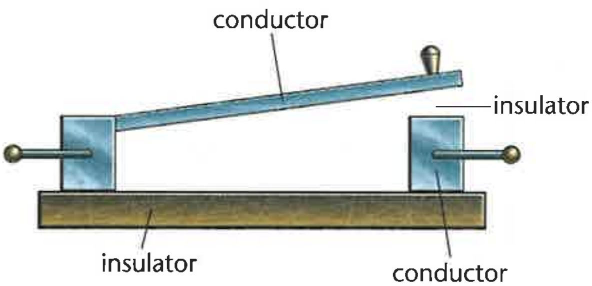
Everyday uses of conductors and insulators

Conductors are used to carry current. All electrical circuits are made of conductors. The inside of electrical cables are made of conductors so that they can carry the current. The pins of a plug are made of conductors.

Insulators are used for safety. They stop the current flowing. Cables and plugs are covered with insulators.



Switches



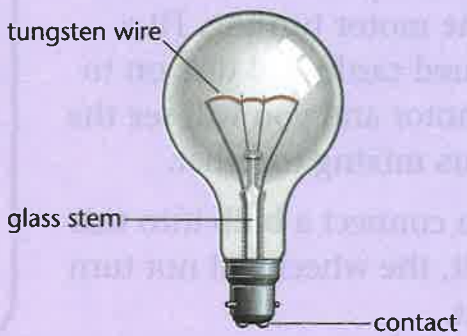
The contacts in a switch are made of metal, a conducting material, so that the current can flow through it.

When the switch is opened it uses the air, a non-metal, as an insulator to stop the current flowing.

1 Which of these objects are electrical conductors and which are insulators? For each object, explain your choice.
   - a a gold wedding ring
   - b a cork
   - c aluminium foil
   - d an elastic band

2 Fishing near overhead cables is always dangerous. Explain why using a graphite fishing rod makes it more dangerous.

3 Here is a picture of an electric lamp. Write down which of the parts labelled are conductors and which are insulators.



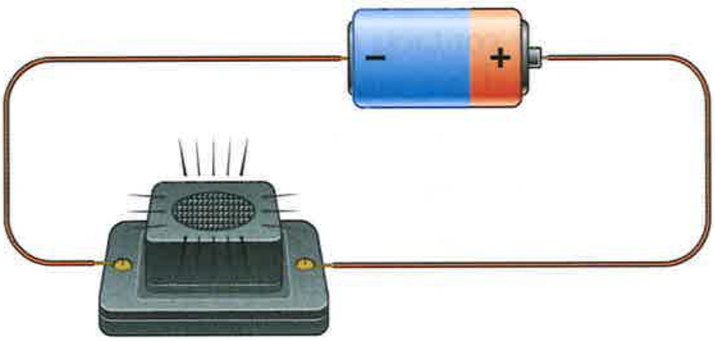
Buzzers and motors

A buzzer in a circuit will make a noise. A motor in a circuit turns a wheel. Some buzzers work only if the electricity is flowing in one direction. If the flow is reversed, the buzzer does not work. Motors turn in the opposite direction when the flow of electricity is reversed.

Buzzers

A **buzzer** makes a noise when it is connected to a battery in a circuit. If you make a circuit with a battery, leads and a buzzer, you will hear the noise.

▼ *The buzzer makes a noise when the circuit is complete.*

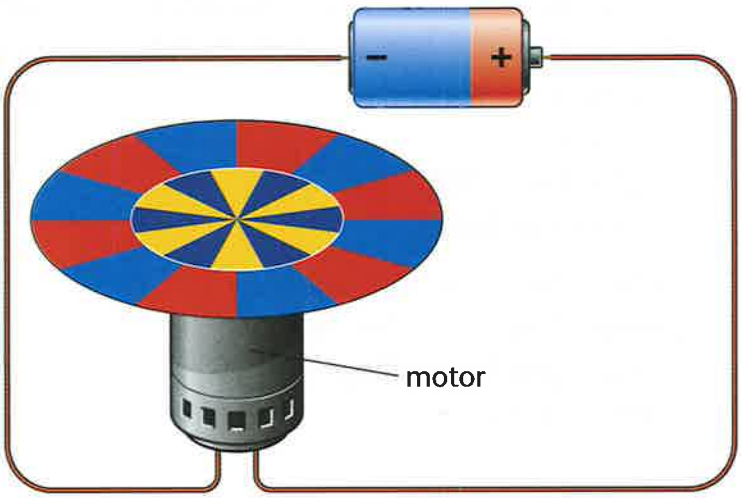


If you connect the leads to the opposite sides of the buzzer it may stop working. For some buzzers, the electricity can pass in only one direction.

Motors

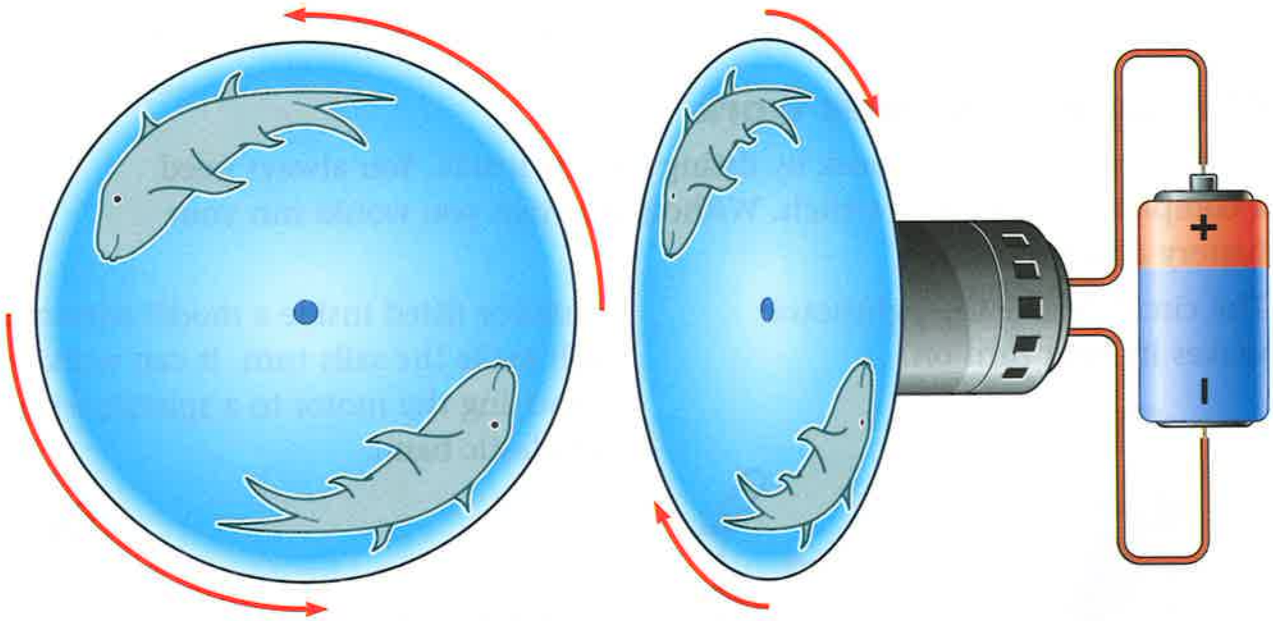
If you connect a **motor** into the circuit you will be able to see the motor turning. Fit a coloured cardboard disc on to the motor and you will see the colours mixing together.

If you connect a bulb into this circuit, the wheel will not turn as fast.



How can we make the wheel change direction?

Look at this picture drawn on a cardboard disc. If you fit this disc on to the motor, you can see the fish moving in one direction. The leads must be connected to the battery and to the motor.



If you remove the leads from the battery and connect them to the opposite terminals, the motor will turn in the opposite direction. You will be able to see the fish swimming backwards.

Electricity flows from the positive terminal of the battery to the negative terminal. When you change the leads round, the electricity passes through the motor in the opposite direction. This makes the motor turn in the reverse direction.

1 What do you need to make a buzzer work?

2 How can you make a motor turn backwards?

3 Draw a picture of how you make two things work in a circuit, for example a lamp and a buzzer.

4 Mina was making her picture of a toy car turn on a disc attached to a motor. It was going too fast and she wanted to slow it down. Write down how she could do this or draw a picture.

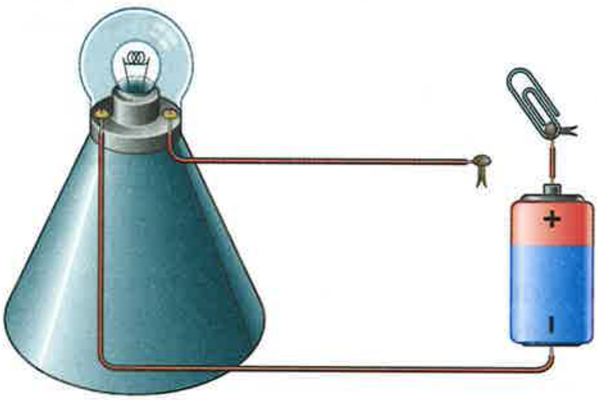
More circuits

Circuits can be used to make your models light up or work. It is important to use a battery with the correct voltage for the job it has to do. You can make a circuit which will do a number of different jobs.

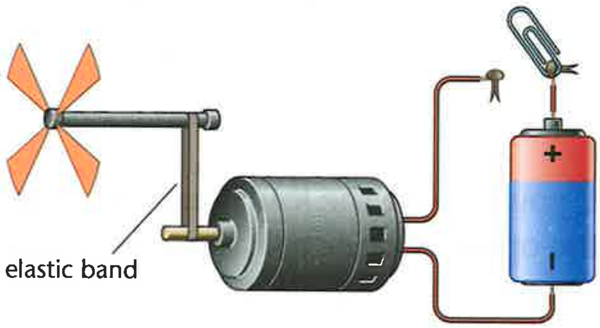
Making your models work

Models can be made to work by fitting circuits inside. You always need a complete circuit and a switch. Without a switch you would run your battery down quickly.

The circuit inside the lighthouse makes its light turn on.

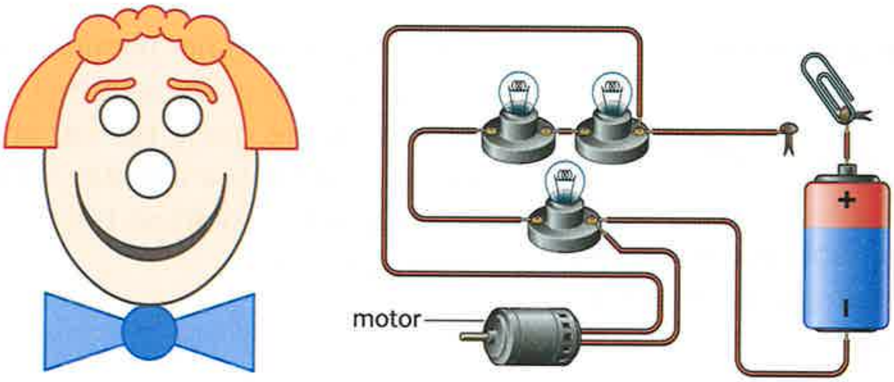


A motor fitted inside a model windmill will make the sails turn. It can work by attaching the motor to a spindle with an elastic band.



Can we add more to a circuit?

You can add more parts into a circuit. In this one the clown's face has eyes and a shiny nose that light up. It also has a bow tie that spins.



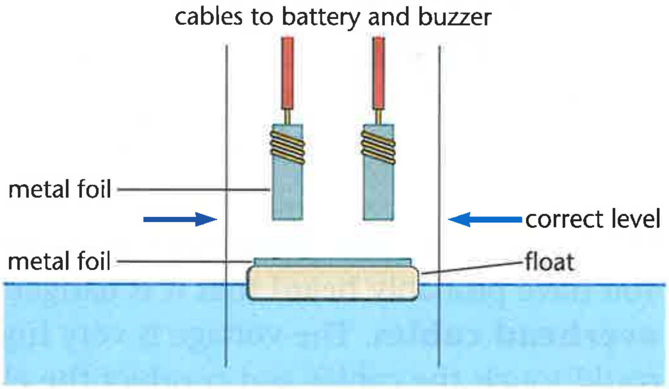
Can you find a way to stop the bath from overflowing?

Daniel was often in trouble. He would turn on the water to run his bath and then forget about it. Water would overflow. He decided to make himself an alarm that would warn him when the bath was full.

This is how he solved the problem. He made a special type of switch and fitted this into a circuit with a buzzer. Daniel covered a plastic float with metal foil. Then he connected two pieces of metal foil to the leads in the circuit inside a large tube.

As the bath filled with water, the float rose. When the water was at the right level, the metal on the float touched the two pieces of metal. This completed the circuit. The buzzer sounded so that Daniel knew his bath was ready.

▼ *Daniel's water level checker.*



DANGER!
It is very dangerous to use mains electricity near water.
It can kill!
Daniel's circuit is only safe because he is using a battery with a low voltage.

1 Write down how to make a light turn on and off in a model house.

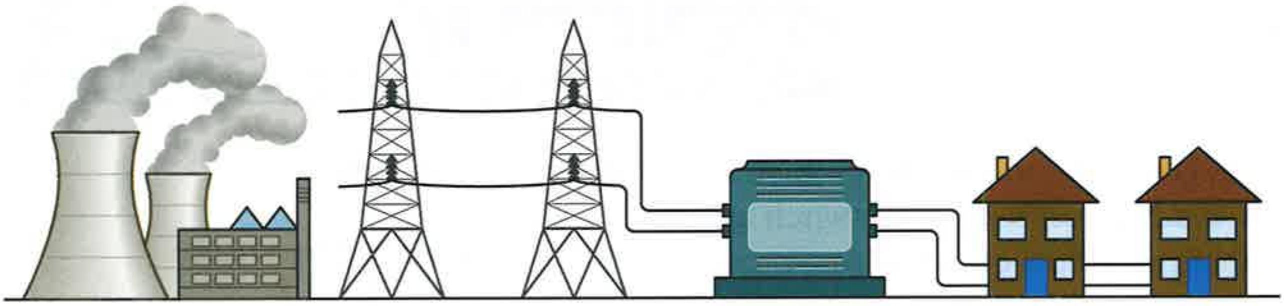
2 Draw the circuit you would use to make the wheels on a toy car turn.

3 Matthew and Mina wanted to put lights in the three rooms of their doll's house. They wanted to be able to switch them on and off separately. Draw the circuit they will need to use to do this.

Being safe with electricity

Overhead cables carry a very high voltage. Electricity in the home is 240 volts which is dangerous. If you touch any part which is bare metal when the electricity is turned on, you can get a serious electric shock. This might kill you.

Where does our electricity come from?



Electricity is carried from **power stations** by cables to your home. You have probably heard that it is dangerous to fly a kite near **overhead cables**. The voltage is very high. The string of a kite could touch the cables and conduct the electricity through you.

In every town there are a number of small buildings called transformer stations. Here the electricity from the overhead cables is changed to a lower voltage for use in your home.

These buildings always have signs warning you to keep out as it is high-voltage electricity. Do not go near them.

Underground cables carry the electricity to your home. The voltage is now 240 volts but this is still dangerous. This is called **mains electricity**.

What dangers are there in your home?

The circuits you have made at school use only low voltages. Your batteries are only about 3 volts. It is quite safe to touch wires carrying 3 volts. Electric train sets run on 6 to 12 volts. This is still fairly safe.

However, the voltage in the circuits in your home is 240 volts. This is much higher and touching **live wires** can cause serious injuries or death. Here is a picture of some dangers to avoid.

Can you spot *five* dangers in this picture?

1 Why are overhead cables dangerous?

2 What is the voltage of electricity in your home?

3 What voltage does an electric train set use?

4 Write down five things that are dangerous to do near electricity.

5 Draw a poster which shows how to use electricity safely.

Test your knowledge

1

These words are all connected with electricity. Copy the crossword on to squared paper and fill in the blanks. Then write your own clues for these words.

2 Design a game that will teach young children how to be safe with electricity.

3 Match each statement to the correct word.

this turns when electricity flows through it	**switch**
this makes a noise when switched on	**motor**
this will turn a circuit on or off	**bulb**
a wire in this gets hot and gives out light	**buzzer**

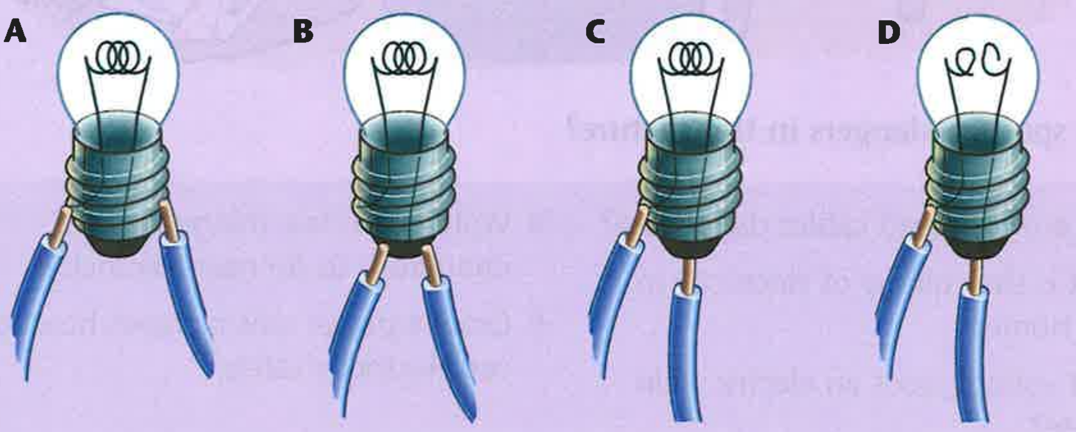
4 Write these sentences in your book using words from the list to fill in the spaces.

The power of a battery is measured in .... The .... the voltage, the more work it can do. A bulb in a .... will be .... if a higher voltage .... is used.

battery, higher, brighter, volts, circuit

5 Which of these bulbs will work when connected into a complete circuit?

For each one, explain why it will or will not work.



Glossary

Keeping animals healthy

bones The parts of an animal's body which make the skeleton.

canines Pointed teeth used for holding and tearing food.

carnivores Animals that eat other animals.

decay The rotting of a tooth caused by bacteria and sugars on the tooth making acid.

energy You use this when you do work like climbing stairs, lifting a bag or playing a game. You also need it for growing.

herbivores Animals that eat plants.

incisors Sharp teeth used for biting food.

mammals Animals which have live babies and make milk to feed their young, such as cows and humans.

milk teeth First set of human teeth that come out as permanent teeth grow.

molars Teeth with flat tops used for grinding food.

muscles Fleshy parts of the body, joined to bones to make them move.

omnivores Animals that eat meat and plants.

permanent teeth Second set of human teeth, that form underneath milk teeth and push them out as they grow.

skeleton The collection of bones which hold the body together and support it.

support Keeping a body firm so that it can move.

Growing and living together

consumer Animals are all consumers because they eat plants or other animals.

environment A place where animals and plants live because of the conditions there.

food chain A diagram showing who eats what. It starts with a plant which is eaten by an animal, which is eaten by another animal, and so on.

germination When seeds first start to grow and produce tiny roots and shoots.

habitat A place where a plant or animal lives.

key This is used to place things into their correct group or to identify them.

leaves The part of a plant which makes the food for the plant.

nutrients Dissolved substances that plants take up from the soil to help them make food.

predators Animals that hunt and feed on other animals or birds.

prey Animals that are eaten by other animals, such as birds are eaten by foxes, mice are eaten by owls.

producers Green plants which use energy from the Sun to make their own food.

roots The part of a plant, usually in the soil, which helps keep it firmly in place and take water and nutrients from the soil into the plant.

seedling A baby plant, or a plant which has just germinated with a few leaves and roots.

stems The main body or stalk of a plant.

Materials and their properties

absorbent Able to take in and hold liquid.

Celsius A scale used to measure temperature.

dull Does not reflect light.

fabric Manufactured cloth.

flexible Able to bend easily without breaking.

insulate To cover something to keep it hot or cold for longer.

manufactured Made by humans. When a raw material, such as wood, is changed into a new material, such as paper, it has different properties.

metal A material which is a good thermal conductor and a poor thermal insulator.

moulded Made into a new shape.

plastic A material which is a poor thermal conductor or a good thermal insulator.

property A characteristic of a material.

rubber A material which is a poor thermal conductor or a good thermal insulator.

shiny Reflects light.

temperature A measure of heat energy, or how hot or cold something is.

thermal conductor A material that allows heat to pass through easily.

thermal insulator A material which does not allow heat to pass through easily.

thermometer An instrument for measuring temperature.

transparent Lets light through. Glass is transparent.

waterproof Prevents water from passing through.

wood A material which is a poor thermal conductor or a good thermal insulator.

Solids, liquids and mixtures

clay Very fine particles, often found in soil.

filter To remove impurities or separate an undissolved solid from a liquid by passing a mixture through a filter paper.

filter paper A special paper which contains very small holes which let a liquid through but keep a solid back.

freeze To change a liquid material into a solid by cooling it down.

humus The part of the soil made from small pieces of dead animals, plants and animal dung that are broken down by soil bacteria (micro-organisms).

insoluble A substance which does not dissolve in a liquid.

irreversible Cannot be change back to its original state.

liquid One of the three states of materials, liquids pour and spread out to take the shape of the container.

measuring cylinder A piece of scientific apparatus for measuring the volume of a liquid in cm^3.

melt To change a material which is solid into a liquid.

meniscus The curved upper surface of a liquid in a tube.

mixture A combination of two or more different materials which can be separated out again.

reversible Can be changed back into its original state.

sand Small rounded grains of rock especially found on the seashore, river beds and deserts.

scale A set of marks which are evenly spaced out on a measuring device. These enable you to measure the amount the device is measuring.

sieve Separating small pieces of solid materials from each other by passing them through a utensil which has a meshed bottom.

soil The upper layer of the Earth which is made up of ground down rock and the remains of dead plants and animals.

solid One of the three states of materials. Solids keep their shape unless you give them a force.

suspension A liquid in which particles are mixed which do not seem to float or sink.

All about forces

air resistance The force that air exerts on a moving object.

attract To pull towards each other.

force A push, pull, twist or turn.

force meter A simple instrument for measuring forces. A simple newton meter.

friction The action of one object rubbing against another or the resistance an object encounters in moving over another.

gravity The force that causes all objects to fall towards the centre of the Earth.

magnet An object made from one of the metals iron, nickel or cobalt. These attract other objects made from these materials.

magnetic Able to be attracted to a magnet. Having the properties of a magnet.

newton The unit of force named after the famous English scientist, Sir Isaac Newton. Often abbreviated to N.

newton meter An instrument used to measure forces.

non-magnetic Not being attracted to a magnet.

opposite Exactly different from something else in every way.

poles The ends of a magnet where the magnetic force is concentrated.

pull To give an object a force and make it move towards you.

push To give an object a force and make it move away from you.

repel To push away from each other.

similar The same as something else.

sink To fall down slowly through water.

squash To crush or squeeze flat.

stationary Not moving at all.

streamlined Having a smooth shape so that air or water flows easily over it.

stretch To make something longer by pulling it from opposite directions.

surface area The area of the surface of an object.

turn A circular movement.

twist To change the shape of an object by rotating one end and not the other or the two ends in opposite directions.

water resistance The force that water exerts on a moving object.

Light and shadows

axis (of the Earth) An imaginary line about which the Earth spins.

direction The line along which something moves or looks.

eyes The parts of your body that allows you to see things.

light A kind of energy that makes things visible.

mirror A polished surface which reflects an image.

opaque Not see through. Lets no light through at all. Examples of opaque materials are metal, foil and wood.

reflect To bounce back from a surface in the opposite direction.

shadow A patch of shade formed when light traveling from a source is blocked.

source of light A point where light appears to be coming from.

Sun The star round which the Earth orbits and from which it receives all its light and warmth.

sunrise The time at which the Sun appears early in the morning.

sunset The time when the Sun disappears from view early in the evening.

translucent Allows light to pass so that an object can only be partially seen. Examples of translucent materials are thin fabric, greaseproof paper and bubble wrap.

transparent Allows light to pass through a material so that something on the other side can be seen clearly. Examples of transparent materials are glass, perspex and cling film.

Electrical circuits and conductors

appliance A household device which uses electricity. Cookers and washing machines are electrical appliances.

battery This provides the power which causes electricity to flow in the circuit. It is made of two or more cells.

bulb An electrical component which lights up when it is placed in a circuit. A thin wire inside gets hot and glows.

buzzer An electrical component which buzzes when electricity flows through it.

cell A device which changes energy stored in chemicals into electrical energy. A battery is made of two or more cells joined together.

circuit Components joined together by wires make a circuit. Electricity can flow round the circuit.

conductors Materials which allow electricity to flow. Metals are good conductors, plastic and rubber are not.

insulators Materials which do not allow electricity to flow such as plastic and rubber.

leads The wires used to connect the different parts (components) of an electrical circuit together.

live wires Wires which are connected to the mains electricity. They can give you a powerful shock or even kill you.

mains electricity Electricity which is supplied to and used in the home.

motor An electrical component which allows a wheel to rotate when electricity flows through it.

overhead cable Wires that carry electricity which has a lot of energy (high voltage) over long distances.

power station A building which has special machines to produce electricity from fuels and send it out to our homes, shops and factories.

switch A device used in a circuit. When it is 'off' it stops the electricity flowing. When it is 'on' the circuit will be complete.

terminals The parts of a battery to which the leads must be connected in a circuit.

voltage The power needed to push electricity round the circuit.

volts The units for measuring the power of a cell or battery. Cells are 1.5 volts. Batteries are 3 volts or more.

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